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FEED COST OF EGG PRODUCTION.

RESULTS OF THREE YEARS' EXPERIMENTS AT THE GOVERNMENT POULTRY FARM.

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CONTENTS.

Page.
Objects of the work ... 1
Description of stock and conditions ... 2
Methods of feeding ... 3
Hens balancing their own rations ... 6
Feeding value of poultry feeds ... 11
Free range compared with large yards ... 16
Consumption of grit and oyster shell ... 18
Leghorns compared with general-purpose fowls ... 19
Egg yield as affected by time of maturity and age of fowls ... 20
Weight of eggs ... 21
Distribution of egg production ... 24
Feed cost of eggs ... 27
Feed used in producing eggs ... 30
Value of the eggs from each pen ... 32
Broodiness in fowls ... 34
Effect of the molt on egg yield ... 35
Variation in weight of the hens ... 36
Balanced rations ... 37
Summary ... 40

OBJECTS OF THE WORK.

Complete data on the feed cost of egg production for fowls kept on free range or on conditions somewhat similar to those existing on general farms are very limited. The main object of the experiments reported in this bulletin was to compare the results obtained through the use of simple rations and methods and to record the feed cost of egg production under these conditions. Only the feed costs are considered, because most of the pens were on free range, scattered over a wide area to keep the fowls from mixing, which, with the keeping of records, weighing the eggs and grain, etc., involved much work which would be unnecessary under commercial conditions. Careful observations were made of the conditions which affect egg production, such as molting and broodiness, and detailed records were kept of the feed used and of the weight of the eggs. These experiments were started in the fall of 1912 with six pens of 30 pullets each. New pens have been added each year subsequently, and the original pens are still being kept to study the effect of the feed and of the age of the fowls on egg production. The results secured in 16 pens, containing 366 fowls, are given in this bulletin, including three complete years' work of the first six pens. The work was conducted on the experimental farm of the Bureau of Animal Industry, near Beltsville, Md. Prices of individual grains in 1917 are from 20 to 100 per cent higher than the prices used in this bulletin, which should be carefully considered in estimating the present cost of egg production.

DESCRIPTION OF STOCK AND CONDITIONS.

Most of the feeding tests were started with 30 standard-bred pullets, bred and reared on the farm under the same conditions, and selected for vigor, standard shape, and color. Some of the flocks consisted of fowls of one breed, while others contained more than one kind of pure-bred fowls of the general-purpose type in the same flock, including Barred Plymouth Rocks, White Wyandottes, Rhode Island Reds, and Buff Orpingtons (see Plates I to IV). Pens 10 to 14, inclusive, also contained some cross-bred pullets. These flocks were housed in colony houses similar to those shown in Plates III and V. The house shown in Plate III is 10 feet long by 7 feet wide, and that in Plate V is 6 feet long by 5 feet wide; both houses are described in detail in Farmers' Bulletin 574 of this department. A better average result is secured by using 30 fowls in each pen than is obtained from smaller flocks, as the effect of any variation due to individuals is reduced greatly. Except three pens which were confined to good-sized yards, all the fowls were allowed free range over several acres of rough land, part of which is in woods and the rest is covered with grass and weeds. The soil is a heavy clay, which does not drain freely.

TABLE 1.—*Pens, rations, and conditions.*

Pen No.	Date experiment began.	Number of pullets.	Breed.	How kept.	Feed.	
					Scratch mixture.	Mash.
1	Nov. 1, 1912	30	Rhode Island Reds..	Free range..	$\frac{1}{3}$ cracked corn, $\frac{1}{3}$ wheat, $\frac{1}{3}$ oats.	$\frac{1}{4}$ bran, $\frac{1}{4}$ middlings, $\frac{1}{4}$ corn meal, $\frac{1}{4}$ beef scrap.
2	.....do.......	30	21 White Wyandottes, 6 Buff Orpingtons, 3 Barred Plymouth Rocks.	.....do......	$\frac{1}{2}$ cracked corn, $\frac{1}{2}$ wheat.	Same as for Pen 1.
3	.....do.......	30	14 Buff Orpingtons, 16 Rhode Island Reds.	Yarded.....	Same as for Pen 1.	Bran, middlings, corn meal, and beef scrap, each in separate hoppers.
4	Jan. 18, 1913	30	White Leghorns.....	Free range..	.....do..........	Same as for Pen 3.
5	.....do.......	30	19 Barred Plymouth Rocks, 2 White Plymouth Rocks, 6 Rhode Island Reds, 3 Buff Orpingtons.	Yarded.....	.....do..........	9 per cent bran, 9 per cent middlings, 63 per cent corn meal, 19 per cent beef scrap.

Table 1.—*Pens, rations, and conditions*—Continued.

Pen No.	Date experiment began.	Number of pullets.	Breed.	How kept.	Feed.	
					Scratch mixture.	Mash.
6	Jan. 25, 1913	30	11 Barred Plymouth Rocks, 1 White Plymouth Rock, 3 White Orpingtons, 3 Buff Orpingtons, 9 White Wyandottes, 3 Rhode Island Reds.	Free range..	$\frac{1}{4}$ cracked corn, $\frac{1}{4}$ wheat, $\frac{1}{4}$ oats, $\frac{1}{4}$ barley.	Beef scrap and a mixture of equal parts corn meal and middlings in separate hoppers.
7	Dec. 1, 1913	30	White Leghorns.....	Yarded.....	Same as for Pen 1	Same as for Pen 3.
8	.....do.......	30	White Leghorns.....	Free range..	......do..........	4 per cent bran, 4 per cent middlings, 66 per cent corn meal, 26 per cent beef scrap.
9	.....do.......	30	9 Barred Plymouth Rocks, 2 White Plymouth Rocks, 11 Buff Orpingtons, 8 Rhode Island Reds.	.....do......	.....do..........	$\frac{1}{4}$ bran, $\frac{1}{4}$ middlings, $\frac{1}{2}$ corn meal.
10	Nov. 1, 1914	8	4 Rhode Island Reds, 3 Crosses, 1 Barred Plymouth Rock.	.....do......	......do.........	3 parts bran, 1 part middlings, 2 parts corn meal, 3 parts cottonseed meal.
11	.....do.......	8	4 Rhode Island Reds, 3 Crosses, 1 Barred Plymouth Rock.	.....do......	.....do..........	2 parts bran, 1 part middlings, 2 parts corn meal, $\frac{1}{4}$ part beef scrap, 2 parts cottonseed meal.
12	.....do.......	8	5 Rhode Island Reds, 2 Crosses, 1 Barred Plymouth Rock.	.....do......	.....do..........	Same as Pen 8.
13	Jan. 19, 1915	18	7 Rhode Island Reds, 6 Crosses, 3 Barred Plymouth Rocks, 2 Buff Orpingtons.	.....do......	.....do..........	1 part bran, 1 part middlings, 2 parts corn meal, 1 part fish meal.
14	.....do.......	18	6 Rhode Island Reds, 8 Crosses, 2 Buff Orpingtons, 2 Barred Plymouth Rocks.	.....do......	.....do..........	1 part bran, 1 part middlings, 2 parts corn meal, 1 part beef scrap.
15	Mar. 2, 1915	24	13 White Leghorns, 11 Barred Plymouth Rocks.	.....do......	.....do..........	Same as Pen 10.
16	.....do.......	12	7 Barred Plymouth Rocks, 5 White Leghorns.	.....do......	.....do..........	Same as Pen 11.

All parts are by weight.

METHODS OF FEEDING.

The scratch mixture of whole or cracked grains was fed twice daily in 2 to 3 inches of straw litter on the floor of each pen, feeding about one-third of the grain in the morning and the rest at night. Hoppers containing a dry mash, or mixture of ground grains, were kept open before the fowls all the time. The amount of the scratch mixture was fixed during 1912 and 1913 so that the fowls ate about one-third mash and two-thirds grain. As there appeared to be a tendency for all the hens except the Leghorns to become too fat and not exercise enough under this method, the amount of scratch grains was reduced in 1914 so that the hens ate about equal parts of the grains and of the mash. This is the method of feeding now being used and appears to be a good one to follow. Coarse grit and oyster shell were fed on the ground near the houses, and green feed was supplied to the pens not having free range. The pens were put into the experiment as soon as the pullets were mature, except Pens 13, 14, 15, and 16, which were started on special tests some time after the pullets had matured and started to lay. The time of maturity materially affects the egg yields of fowls during their pullet year, and should be considered in comparing Pens 4, 5, and 6, in Table 2 (first year) with the other pens. The following regular records were kept for each pen: A daily record of the number and weight of the eggs; a weekly feed record of the grain, mash, and green feed; and a monthly record of the weight of each hen. All rations are by weight.

TABLE 2.—*Average egg yield and feed cost per hen, weight of eggs, etc.*

FIRST YEAR, PENS 1 TO 6.

Pen No.	Average egg yield per hen.	Feed per hen.		Feed per dozen eggs.		Average value of eggs per hen over feed cost.	Average weight per dozen eggs.	Number times hens broody.	Number hens died, etc.
		Lbs.		*Lbs.*	*Cents.*		*Pounds.*		
1	142.2	74	$1.17	6.24	9.89	$2.86	1.58	56	4
2	145.1	59	.94	4.87	7.74	3.26	1.55	70	4
3	125.6	73	1.16	7.00	10.90	2.50	1.54	94	5
4	137.8	55	.87	4.68	7.34	2.72	1.42	0	5
5	121.7	75	1.16	7.34	11.24	2.17	1.54	111	3
6	118.0	81	1.33	8.10	13.18	1.88	1.53	68	5
Average	131.7	70	1.11	6.37	10.00	2.56	1.53	67	4.3

SECOND YEAR, PENS 1 TO 6.

Pen No.	Average egg yield per hen.	Feed per hen.		Feed per dozen eggs.		Average value of eggs per hen over feed cost.	Average weight per dozen eggs.	Number times hens broody.	Number hens died, etc.
1	92.9	69	$1.07	9.2	14.4	$1.25	1.65	46	7
2	78.2	59	.95	9.2	14.6	1.08	1.59	44	3
3	77.8	67	1.03	10.3	16.0	1.08	1.62	74	0
4	115.9	54	.85	5.6	8.7	2.18	1.50	4	3
5	100.3	73	1.15	8.6	13.5	1.67	1.60	82	6
6	91.1	83	1.32	10.6	16.9	1.22	1.62	66	4
Average	92.7	68	1.06	8.9	14.0	1.41	1.60	62	3.8

FIRST YEAR, PENS 7 TO 9.

Pen No.	Average egg yield per hen.	Feed per hen.		Feed per dozen eggs.		Average value of eggs per hen over feed cost.	Average weight per dozen eggs.	Number times hens broody.	Number hens died, etc.
7	120.9	56	$0.88	5.6	8.7	$2.45	1.46	2	1
8	157.6	56	.88	4.2	6.7	3.41	1.47	7	4
9	90.0	61	.88	8.2	11.7	1.55	1.50	76	2
Average	122.8	58	.88	6.0	9.0	2.47	1.48	....	2.3

THIRD YEAR, PENS 1 TO 6.

Pen No.	Average egg yield per hen.	Feed per hen.		Feed per dozen eggs.		Average value of eggs per hen over feed cost.	Average weight per dozen eggs.	Number times hens broody.	Number hens died, etc.
1	71.4	82	$1.31	14.1	22.4	$0.39	1.75	25	5
2	59.4	75	1.23	16.0	26.0	.11	1.66	27	3
3	59.9	65	.97	13.1	19.5	.65	1.61	47	5
4	112.1	56	.84	6.0	8.8	1.94	1.49	2	5
5	82.9	76	1.19	11.0	17.2	.95	1.63	46	0
6	83.4	90	1.40	12.9	20.0	.71	1.62	32	1
Average	78.2	74	1.16	12.2	19.0	.79	1.63	30	3.2

TABLE 2.—*Average egg yield and field cost per hen, weight of eggs, etc.*—Continued.

SECOND YEAR, PENS 7 TO 9.

Pen No.	Average egg yield per hen.	Feed per hen.		Feed per dozen eggs.		Average value of eggs per hen over feed cost.	Average weight per dozen eggs.	Number times hens broody.	Number hens died, etc.
		Lbs.		*Lbs.*	*Cents.*		*Pounds.*		
7	107.0	56	$0.84	6.2	9.4	$1.92	1.46	7	0
8	151.8	59	.93	4.7	7.5	2.81	1.52	1	5
9	84.3	74	1.07	10.7	15.3	1.07	1.56	43	6

FIRST YEAR, PENS 10 TO 16.

Pen No.	Average egg yield per hen.	Feed per hen.		Feed per dozen eggs.		Average value of eggs per hen over feed cost.	Average weight per dozen eggs.	Number times hens broody.	Number hens died, etc.
10	103.8	74	$1.10	9.0	13.4	$1.39	1.59	14	2
11	102.3	69	1.01	7.9	11.9	1.53	1.56	6	2
12	169.5	89	1.44	6.3	10.2	3.14	1.54	17	0
13	145.4	68	1.02	5.6	8.5	2.96	1.51	36	0
14	160.0	84	1.32	6.2	9.7	3.03	1.47	22	2
15	33.2	62	.91	21.4	31.9	.04	1.37	2	9
16	67.6	60	1.04	12.0	18.0	.63	1.45	10	4

This table is arranged consecutively according to the year that the experiment was conducted.

The averages of pens 7 to 16 are not included because deficient rations were fed in several of these pens, making such averages of no value.

Missing hens and those killed by hawks are included with the hens that died (last column of table) as follows: Second year, missing, one from Pen 1, two from Pen 2, one from Pen 4, and one from Pen 6; killed by hawks, one from Pen 4, and two from Pen 8; third year, missing or killed by hawks, two from Pen 4, three from Pen 8, two from Pen 9, one from Pen 10, four from Pen 15, and two from Pen 16.

The cost of the green feed which was fed in the yarded pens (Nos. 3, 5, and 7) is not included in this table. It amounts to about 10 cents per hen, or 1 cent per dozen eggs (see p. 18). All costs throughout this bulletin are figured on the basis of feed only and do not include labor or any other items.

The general-purpose breeds ate an average of about 70 pounds of both grain and mash per head in one year, while the Leghorns consumed about 55 pounds per head. On this basis, if their feed is regulated so that the hens will eat equal parts of scratch grains and of mash, 100 fowls of the general-purpose breeds should be fed about

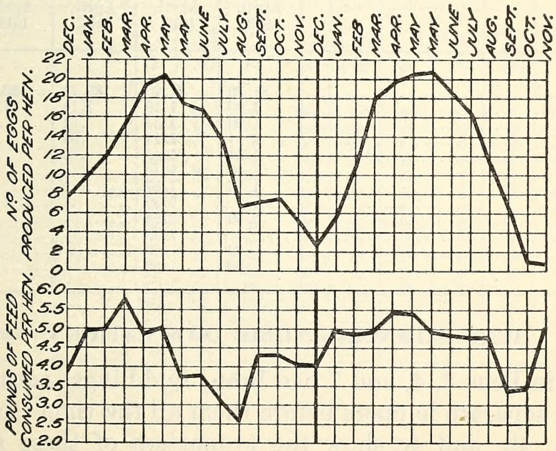


FIG. 1.—Average egg yield and feed consumption per hen in Pen 8 for 2 years by 4-week periods. (This necessitates repetition of month of May so as to make 13 periods in the year.)

9.5 pounds each of grain and of mash daily, and 100 Leghorns should receive about 7.5 pounds of each. (See Table 3 for amount in quarts.) The amount of feed consumed varies considerably throughout the year, being greatest just preceding the period of highest egg production, but it does not vary absolutely with production either during one year or when one year is compared with another. (See fig. 1.) This latter fact is readily seen by comparing the average egg yield and total feed consumption in Pens 1 to 6 for their first and second years (see Table 2). The egg yield decreased about 30 per cent in their second year, while the feed consumption decreased only 3 per cent.

A fair grade of beef scrap with a guaranteed protein analysis of 50 to 55 per cent, fat 12 to 13 per cent, and 1 to 3 per cent of fiber was used. The cracked corn was white, but the corn meal was ground from yellow corn. The prices of some of the grains were changed in April, 1913, to conform to the market price at that time. That price has since been used without change in figuring all the costs in this bulletin. Prices of individual grains in 1917 are from 20 to 100 per cent higher than the prices used in this bulletin. Present prices of grains should be compared to these prices in arriving at the present cost of producing eggs.

TABLE 3.—*Price and weight of grains.*

Grain.	Price per 100 pounds.		Price per bushel.		Weight of 1 quart.	
	Up to April, 1913.	After April, 1913.	Up to April, 1913.	After April, 1913.		
					Lbs.	*Oz.*
Cracked corn	$1.30	$1.20	$0.73	$0.67	1	12
Wheat	1.90	1.79	1.14	1.07	1	14
Oats	1.60	1.34	.51	.43	1	......
Barley	1.74	1.74	.84	.84	1	8
Corn meal	1.35	1.45	.65	.70	1	8
Wheat bran	1.40	1.40	......	......	......	10
Wheat middlings	1.45	1.37	......	......	......	13
Fish meal	......	2.30	......	......	......	......
Beef scrap	2.50	2.65	......	......	1	5
Cottonseed meal	......	1.85	......	......	......	......
Grit	.60	.60	......	......	......	......
Oyster shell	.60	.60	......	......	......	......

HENS BALANCING THEIR OWN RATIONS.

The fowls in Pens 3, 4, and 7 had bran, middlings, corn meal, and beef scrap in separate hoppers before them all the time (see Table 1). Tables 4, 4a, 4b, and 4c show the proportion of these mash feeds eaten by these pens for each 4-week period.

TABLE 4.—*Percentage of mash feeds consumed each 4-week period (Pens 3 and 4, first year).*

Period.	Corn meal.		Beef scrap.		Bran.		Middlings.	
	Pen 3.	Pen 4.	Pen 3.	Pen 4.	Pen 3.	Pen 4.	Pen 3.	Pen 4.
1912.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
November	55	....	30	....	6	....	9	....
December	61	....	15	....	10	....	14	....
1913.								
January	70	67	13	27	8	4	9	2
February	72	65	17	30	7	2	4	3
March	61	76	21	19	7	3	11	2
April	66	63	15	27	9	5	10	5
May	67	65	23	26	4	4	6	5
May[1]	64	63	20	25	10	6	6	6
June	50	67	19	25	16	6	15	2
July	49	54	24	29	13	10	14	7
August	55	54	22	33	9	6	13	7
September	60	57	21	29	10	7	9	7
October	60	65	21	27	9	4	10	4
November[2]	(52)	65	(25)	19	(12)	8	(11)	8
December	(71)	58	(18)	33	(3)	4	(8)	5
Average	63	63.7	19	27	9	4.9	9	4.4

[1] In this and other tables the year is divided into 13 periods of 4 weeks each, consequently the periods only represent in general the months indicated and thus it is necessary to show two periods in one month during the year (May). The actual dates of these periods for each pen are given in the text following Table 4c.

[2] Figures in parentheses belong to the following year's record and are inserted here to make the monthly comparisons complete; they are not included in the year's average.

TABLE 4a.—*Percentage of mash feeds consumed each 4-week period (second year for Pens 3 and 4, first year for Pen 7).*

Period.	Corn meal.			Beef scrap.			Bran.			Middlings.		
	Pen 3.	Pen 4.	Pen 7.	Pen 3.	Pen 4.	Pen 7.	Pen 3.	Pen 4.	Pen 7.	Pen 3.	Pen 4.	Pen 7.
1913.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
November	52	(65)	......	25	(19)	......	12	(8)	......	11	(8)	......
December	71	(58)	55	18	(33)	34	3	(4)	5	8	(5)	6
1914.												
January	56	67	62	26	18	23	11	7	7	7	8	8
February	70	63	71	18	24	21	5	6	3	7	7	5
March	70	64	73	16	23	18	7	9	5	7	4	4
April	66	55	60	18	31	21	7	7	12	9	7	7
May	63	56	58	21	25	27	8	11	9	8	8	6
May	65	44	52	20	32	28	6	13	11	9	11	9
June	65	57	54	21	27	27	7	8	11	7	8	9
July	64	57	57	19	25	25	9	10	9	8	8	9
August	70	64	59	17	24	25	7	6	7	6	6	9
September	75	81	83	13	18	13	6	0	2	6	1	2
October	82	90	82	8	9	15	3	0	3	7	1	0
November	(87)	88	82	(7)	11	15	(2)	1	2	(4)	0	1
December	(87)	91	(92)	(8)	7	(7)	(2)	1	(0)	(3)	1	(1)
Average	68	68	67	18	21	22	6	6	6	8	5	5

TABLE 4b.—*Percentage of mash feeds consumed each 4-week period (third year for Pens 3 and 4, second year for Pen 7).*

Period.	Corn meal.			Beef scrap.			Bran.			Middlings.		
	Pen 3.	Pen 4.	Pen 7.	Pen 3.	Pen 4.	Pen 7.	Pen 3.	Pen 4.	Pen 7.	Pen 3.	Pen 4.	Pen 7.
1914.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
November	87	(88)	(82)	7	(11)	(15)	2	(1)	(2)	4	(0)	(1)
December	87	(91)	92	8	(7)	7	2	(1)	0	3	(1)	1
1915.												
January	89	96	91	7	3	6	2	1	2	2	0	1
February	92	94	90	5	5	4	1	0	3	2	1	3
March	87	97	88	4	3	8	2	0	2	7	0	2
April	82	87	88	6	6	9	6	3	2	6	4	1
May	76	84	87	9	7	9	7	5	2	8	4	2
May	79	81	85	7	10	10	6	5	4	8	4	1
June	82	85	80	6	8	13	6	4	5	6	3	2
July	80	89	85	9	5	12	5	4	2	6	2	1
August	83	88	82	7	3	13	5	6	2	5	3	3
September	87	89	87	5	6	11	4	3	1	4	2	1
October	74	97	85	14	3	11	4	0	3	8	0	1
November	......	95	88	......	5	12	......	0	......	......	0	......
December	......	96	......	......	3	......	......	0	......	......	1	......
Average	84	91	86	7	5	10	4	2	2	5	2	2

TABLE 4c.—*Average percentage of mash feeds consumed each year.*

Year.	Pen.	Corn meal.	Beef scrap.	Bran.	Middlings.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
1913	3	63	19	9	9
1913	4	63.7	27	4.9	4.4
1914	3	68	18	6	8
1914	4	68	21	6	5
1914	7	67	22	6	5
1915	3	84	7	4	5
1915	4	91	5	2	2
1915	7	86	10	2	2

All the records are based on 13 periods of 4 weeks each, into which each year is divided, This accounts for a repetition of May in these and other tables. The exact periods for the different pens were as follows:

Pens 1, 2, and 3: 1, November 1 to 28; 2, November 29 to December 26; 3, December 27 to January 23; 4, January 24 to February 20; 5, February 21 to March 20; 6, March 21 to April 17; 7, April 18 to May 15; 8, May 16 to June 12; 9, June 13 to July 10; 10, July 11 to August 7; 11, August 8 to September 4; 12, September 5 to October 2; 13, October 3 to October 31. The periods for Pens 4 and 5 begin January 18 and are as follows: 1, January 18 to February 14; 2, February 15 to March 14; 3, March 15 to April 11; 4, April 12 to May 9; 5, May 10 to June 6; 6, June 7 to July 4; 7, July 5 to August 1; 8, August 2 to August 29; 9, August 30 to September 26; 10, September 27 to October 24; 11, October 25 to November 21; 12, November 22 to December 19; 13, December 20 to January 17. Pen 6 began January 25 and continued as follows: 1, January 25 to February 21; 2, February 22 to March 21; 3, March 22 to April 18; 4, April 19 to May 16; 5, May 17 to June 13; 6, June 14 to July 11; 7, July 12 to August 8; 8, August 9 to September 5; 9, September 6 to October 3; 10, October 4 to October 31; 11, November 1 to November 28; 12, November 29 to December 26; 13, December 27 to January 24. Pens 7, 8, and 9 were entered in the experiment December, 1913, a year later than Pens 1 to 6, and their periods are as follows: 1, December 1 to December 28; 2, December 29 to January 25; 3, January 26 to February 22; 4, February 23 to March 22; 5, March 23 to April 19; 6, April 20 to May 17; 7, May 18 to June 14; 8, June 15 to July 12; 9, July 13 to August 9; 10, August 10 to September 6; 11, September 7 to October 4; 12, October 5 to November 1; 13, November 2 to November 30.

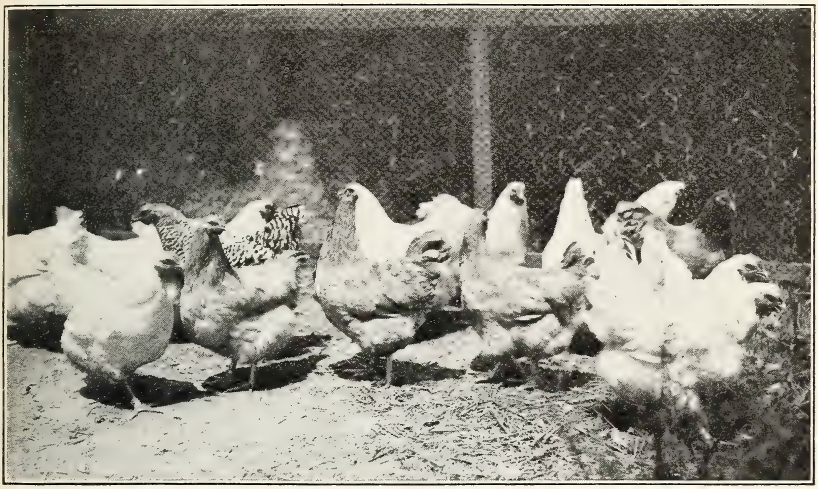


FIG. 1.—PEN 2, MIXED PEN OF GENERAL-PURPOSE BREEDS.

On free range; fed a ration without oats.

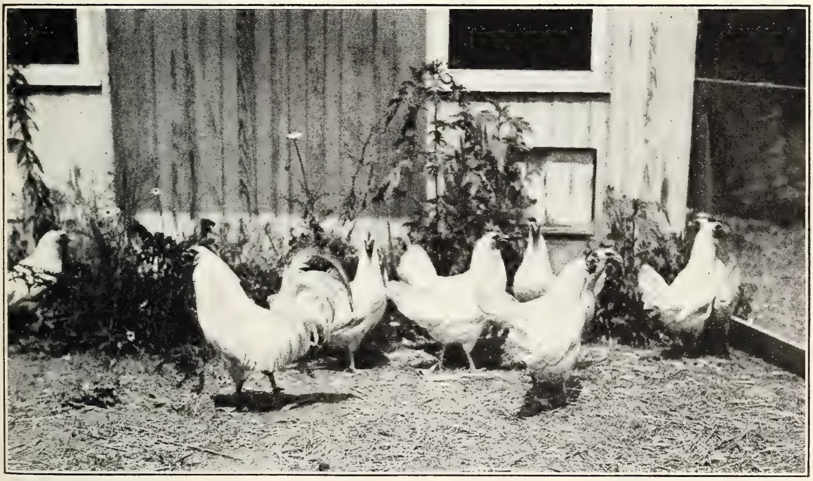


FIG. 2.—PEN 4, SINGLE-COMB WHITE LEGHORNS.

On free range; allowed to select their own mash.

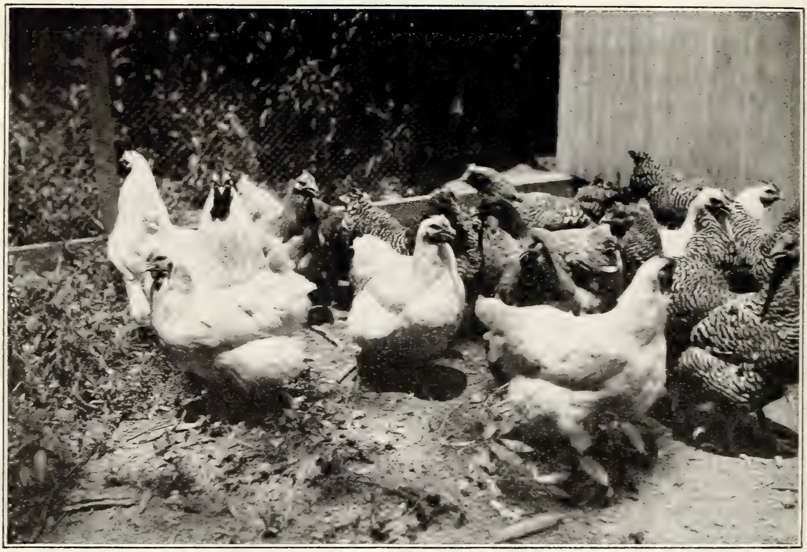


FIG. 1.—PEN 6, MIXED PEN OF GENERAL-PURPOSE BREEDS.

On free range; fed a scratch mixture containing barley, and had beef scrap separate from the mash.

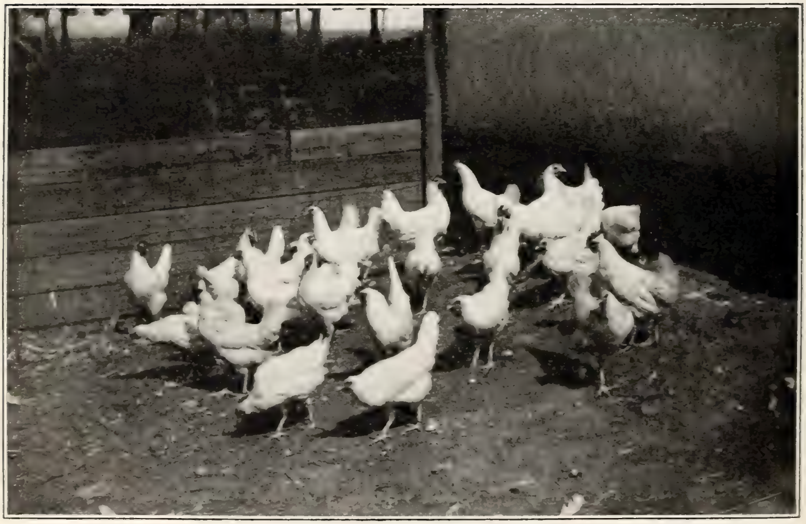
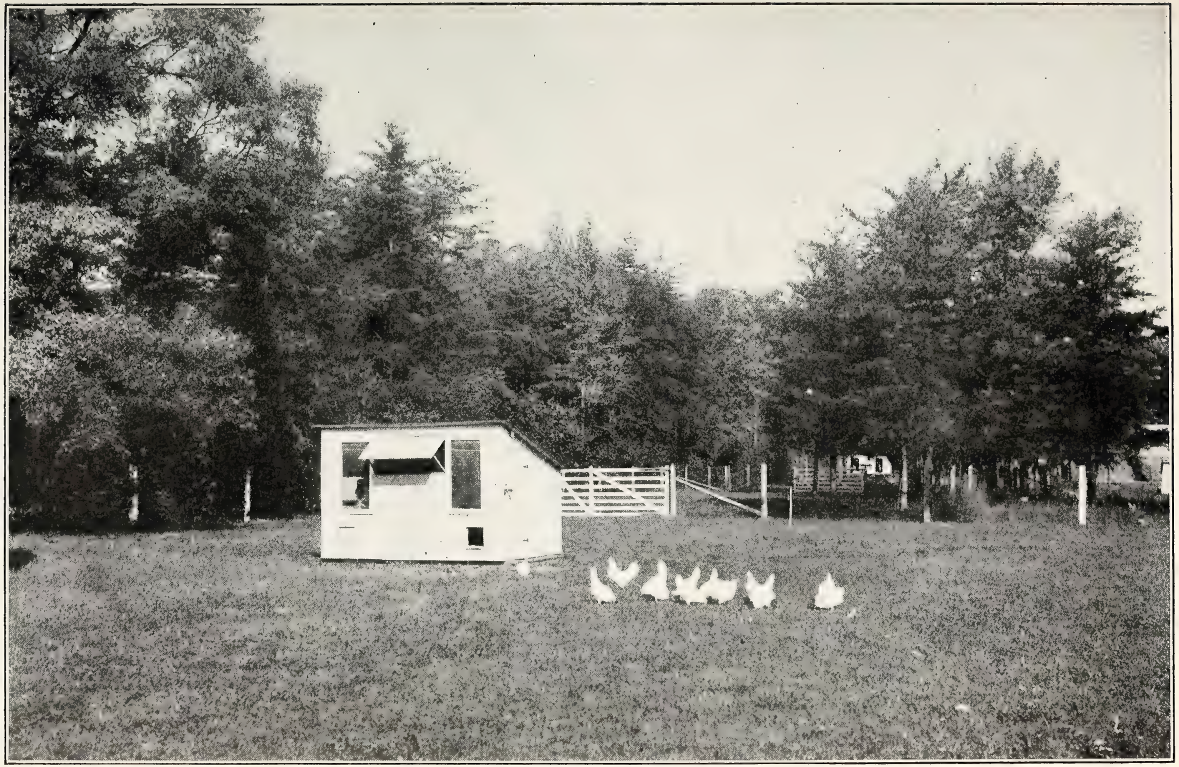


FIG. 2.—PEN 7, WHITE LEGHORNS.

Confined to yard; allowed to select their own mash.



PEN 8, SINGLE-COMB WHITE LEGHORNS.

On free range; fed a mash containing two-thirds corn meal.

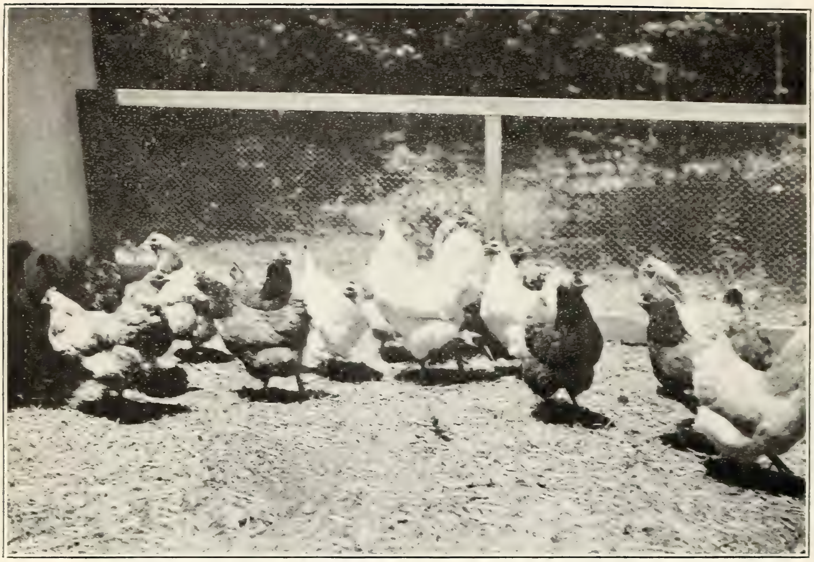


FIG. 1.—PEN 9, MIXED PEN OF GENERAL-PURPOSE BREEDS.

On free range; not fed any beef scrap.

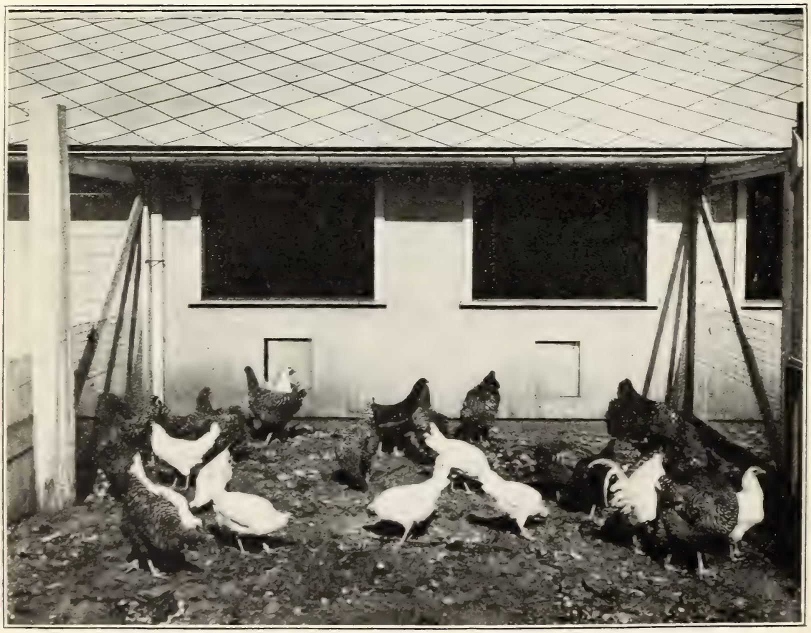


FIG. 2.—PEN 15, WHITE LEGHORNS AND BARRED PLYMOUTH ROCKS.

On free range, fed one-third cottonseed meal in mash.

A study of Tables 4, 4a, 4b, and 4c, and the graphic representation in figure 2 shows a great variation in the proportions of the components of the mash consumed, especially in the corn meal and beef scrap. These percentages, if worked out on a weekly basis instead of for periods of four weeks, fail to show any constant relation between the percentage of either the corn meal or the beef scrap and the temperature or the egg production. The proportions of the grains seem to be influenced materially by the differences in years, or else by different lots of feed, especially beef scrap. This is shown in the figure, where the curves for Pens 3 and 4 in 1913 are different from those in 1914, and the percentages in 1915 are very markedly different from those in either 1913 or 1914.

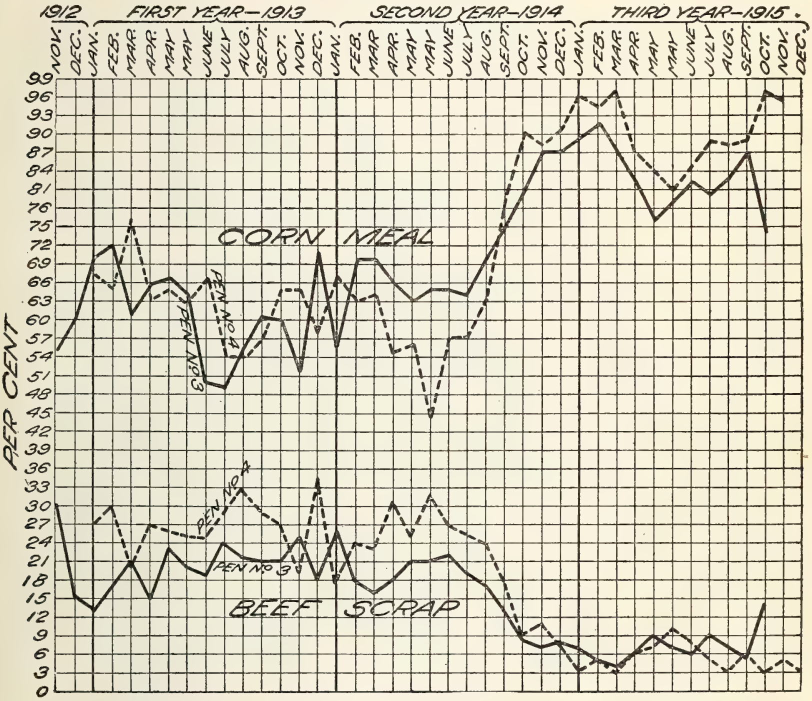


FIG. 2.—Hens balancing their own ration. Percentage of corn meal and beef scrap consumed in mash. (Bran and middlings were before the hens also, but only small quantities were consumed.)

The tendency to increase the percentage of corn meal and decrease that of beef scrap during the molting period is very uniformly marked in 1914 but is not so apparent in 1913. This is rather contrary to the practice of increasing the percentage of protein during the molting period. The Leghorns ate a slightly larger proportion of beef scrap than did the general-purpose fowls, which difference was greater in 1913 than in 1914. The proportion of the grains eaten was also influenced by the quality of the grains, as the fowls apparently liked some lots of feed better than others, although the quality and condition of all the grains were good. The average percentages for the different pens in both years are fairly uniform, as is shown in table 4c.

The results show that hens will not eat too much beef scrap and that they can be allowed to select their own mash feeds. One thing emphasized in this work is the large percentage of corn meal, which is 2 to 3 times as much as is usually recommended in a mash. The large percentage of corn meal in this mash did not tend to make the hens too fat, as shown by the monthly weight records in Table 10. The health of the fowls was in no way adversely affected by the large percentage of corn meal in the mash. Pen 3 went through its entire second year (1913–14) without any sickness or deaths and was the only pen in which no mortality occurred during that year. Pen 5, which also had a large percentage of corn meal in the mash, went through the year 1915, when they were 3-year-old hens, without any deaths.

The mash in Pen 5 was mixed according to the proportions eaten by Pen 3, as shown in Table 1. The mash originally contained 10 per cent bran, 12 per cent middlings, 63 per cent corn meal, and 15 per cent beef scrap, based on what Pen 3 was eating at that time. This was changed after Pen 3 had been in the experiment one year, using the average proportions for the year. Pen 5 laid as well as Pen 3 the first year, considering the difference in the time that the pens were started; and laid 22 more eggs per hen in 1914, producing eggs 2.5 cents per dozen cheaper. In 1915, Pen 5 laid 23 more eggs per hen than Pen 3 and produced eggs 2.3 cents per dozen cheaper. This difference in production during the second and third years is partly, if not entirely, due to the difference in time of year when these pens matured and started to lay. This is discussed more in detail on page 20. Pen 5 also received 12 per cent more beef scrap in 1915 than Pen 3, which tends to account for part of the increased production in the former pen. Pen 5 contained more broody hens in both 1913 and 1914 and the same number in 1915 as Pen 3.

The mash in Pen 8 was mixed according to the proportions eaten by Pen 4. Pen 8 laid 36.7 more eggs per hen than Pen 7 and produced eggs 2 cents per dozen cheaper in 1914, while in 1915 Pen 8 laid 44.8 more eggs per hen and produced eggs 1.9 cents per dozen cheaper than Pen 7. Pens 7 and 8 were started at the same time, but Pen 7 and Pen 4 were allowed to balance their own rations. Pen 7 was confined to a yard while Pens 4 and 8 were on free range. The effect of free range on egg production is discussed on page 16. Pen 8 received about 4 per cent more beef scrap than Pen 7 in 1914 and about 16 per cent more in 1915 and produced the highest average egg yield (158) up to that time in these feeding experiments. This increased percentage of beef scrap in 1915 undoubtedly accounts partly for the increased production in Pen 8. The conclusion to be drawn from Pens 5 and 8, in which the mash was mixed as selected by the hens in Pens 3, 4, and 7, is that just as good results if not better are secured where a fixed mash is used throughout the year as where each mash constitutent is fed separately.

FEEDING VALUE OF POULTRY FEEDS.

THE VALUE OF OATS.

Pens 1 and 2 were fed alike (see Table 1) except that the oats were left out of the scratch ration in Pen 2. The egg yield was about the same in these pens the first year, but Pen 2 ate considerably less feed. Both pens were on free range. Pen 1 laid about 15 more eggs per hen than Pen 2 during their second year, but the feed cost of egg production was about the same (see Table 2). In their third year Pen 1 laid 12 more eggs per hen than Pen 2 and produced eggs 4 cents per dozen cheaper. The average cost of the eggs for three years is slightly in favor of Pen 1, but this difference is less than 1 cent per dozen and may not be entirely due to the difference in rations. The mortality in Pen 1 during the second year, although considerably greater than in Pen 2, was apparently due to the difference in the fowls and not to the feed.

Leaving the oats out of the scratch mixture in Pen 2 increased the cost of the mixture 6 cents per 100 pounds. The hens in Pen 2 tended to get overfat, which may be partly due to the larger proportion of corn in the scratch mixture, but was also affected by the breed of fowls, as discussed on page 36. With the mixture containing oats cheaper than one without this grain, there does not appear to be any reason for leaving it out of the ration, and the oats add variety to the feed. If the cost of a pound of oats should increase out of proportion to corn and wheat, a ration without oats would give good results.

THE VALUE OF BEEF SCRAP OR ANIMAL PROTEIN.

Pen 9 was fed a ration without beef scrap (see Table 1) to determine what results would be secured from fowls kept on free range and fed a standard ration with the animal protein (beef scrap) left out and not replaced by vegetable protein. This pen had an unlimited range in woods containing a brook which supplied bugs and is perhaps in many ways directly comparable to conditions on general farms, where beef scrap or any other material furnishing animal protein is not generally fed.

The fowls in this pen were in good breeding condition, or slightly thin, throughout the experiment, as opposed to the slight tendency to become overfat noted in nearly all other pens of general-purpose fowls. The monthly average weight of the hens in this pen was 5.03 pounds, compared to 5.82 pounds in the other general-purpose pens during their first year, and 5.58 pounds, compared with 6.26 for these pens during their second year (see Table 10). These fowls were always hungry and busy scratching, wandering a considerable distance from their house to scratch in the leaves and on the banks of the brook.

Feather eating developed in this pen and the fowls picked the feathers from the neck of the male. This vice was apparently stopped by keeping salt pork before the birds until the male's neck was healed and covered with new feathers. A slight tendency toward this habit was noted in this pen throughout the year, but was not serious enough to warrant preventive measures except during the month of October, 1914. Feather picking did not develop in any of the other feeding pens, showing that the use of a good ration containing beef scrap practically prevents this vice among fowls kept under ordinary conditions.

The average feed consumed per hen in Pen 9 (see Table 2) was 61 pounds, which cost 88 cents, against an average consumption of 69 pounds which cost $1.09, for Pens 1, 2, and 3 in 1913. The amount of feed increased to 74 pounds during the second year and cost $1.10, compared with 65 pounds in Pens 1, 2, and 3, which cost $1.02. The average feed cost of a dozen eggs in Pen 9 during the first year was 11.7 cents against 9.51 cents in Pens 1, 2, and 3 (1913), and it was 15.3 cents the second year against 15 cents for Pens 1, 2, and 3. It took 8.2 pounds of feed to make a dozen eggs in Pen 9 the first year against 6.04 pounds in Pens 1, 2, and 3, and 10.7 against 9.6 pounds the second year.

The average egg yield in Pen 9 was 90 eggs compared with 137.6 eggs for Pens 1, 2, and 3 during 1913, and 84.3 against 83 in the second year. The 2-year average annual production in Pen 9 was 87.1 eggs against 110.2 eggs in the beef-scrap pens. The 2-year average cost of a dozen eggs was 13.5 cents in Pen 9 against 12.2 in Pens 1, 2, and 3. Pen 9 did not lay well during the winter and practically stopped laying whenever the ground was covered with snow (see Table 6). This affected the value of the eggs materially. Pen 9 was started December 1, while Pens 1, 2, and 3 were put into the experiments November 1, so that the difference in results between these pens is somewhat greater than it would have been if all the pens had started to lay in the same month.

The average weight of a dozen eggs for the first year in Pen 9 was 1.50 pounds against an average of 1.56 pounds for Pens 1, 2, and 3, and 1.56 against 1.62 during the second year. The mortality in Pen 9 was 2 hens compared with an average of 4.3 in Pens 1 to 6 during the first year, but was 4 dead from natural causes in the second year, and 2 killed by the other hens picking and eating their flesh, against 3.3 dead from natural causes in the other pens. The picking was due to the lack of beef scrap or other animal-protein feed. It would not appear that the beef scrap affected the mortality from natural causes in these experiments. No tests were made of the eggs from this pen used for hatching, but of the eggs hatched no differences in fertility or hatchability were noted between this pen and those fed beef scrap.

A study of the results shows that beef scrap or some other animal protein, even with fowls on a good range, was an economical feed and that its use materially increased egg production and the market value of the eggs. This is especially true during the first year's production, which was very materially stimulated by the beef scrap; the second year's results were about equal in the beef scrap and no beef scrap pens. The difference in egg yield would probably be greater with fowls confined to yards. Beef scrap and fish meal appear to be the only feeds in these rations which very materially affect the egg yield. The variation in the proportions of the other feeds, or even the omission of any one of them, does not appear to affect the egg yield as greatly as do these feeds.

COTTONSEED MEAL.

Cottonseed meal is more readily available and is cheaper, especially in the South, than beef scrap. This meal has a high protein content, and if it would give as efficient results considering its relative protein content, it would be a more economical feed than beef scrap. Pens 10 and 11 were started in November, 1914, on rations containing cottonseed meal. Their mash (see Table 1) was composed of about one-third cottonseed meal, and the protein content equaled that of Pen 12, which was fed beef scrap in place of cottonseed meal and used as a check pen. A small amount (about 3.5 per cent) of beef scrap was included in the mash in Pen 11 to see if this amount would supply the mineral matter which might be lacking in the cottonseed meal and make the use of the meal more efficient. The total cottonseed meal in the entire ration of Pens 10 and 11 was about 13 per cent, and about 15 per cent in Pen 15. Pens 15 and 16 were started in March, 1915, on rations similar to those used in Pens 10 and 11, respectively. The method of feeding was similar to that used in the other pens except that it was practically impossible to get the hens fed cottonseed meal to eat enough mash so that half mash and half scratch grains could be fed. The hens were always hungry and were very thin, so that it seemed advisable to feed a larger proportion of scratch grains. The average weights of these hens, as shown in Table 10, were very low, Pens 10 and 11 averaging throughout the year a pound less per hen than Pen 12.

The weights of the hens in all of the cottonseed pens were far below those of hens of the same breeds in beef-scrap pens.

These pens were all on free range and thus were able to secure considerable feed from the range. Several times during the year the hens in Pens 10, 11, and 16 were found to be going to other feeding pens and eating their mash. Their ration apparently was deficient in some desired element, so that they would go long distances to secure other feed. This mixing at least partly accounts for the variable results secured in these pens.

The results with the cottonseed meal, as shown in Table 2, first year, pens 10 to 16, were not satisfactory. Pen 12, fed beef scrap, laid about 66.5 more eggs per hen, produced eggs 2.4 cents per dozen cheaper, and gave a profit over feed cost $1.68 per hen greater than in Pens 10 and 11. The results in Pens 15 and 16 were even more decisive against the use of cottonseed meal as an economical feed, Pen 15 averaging only 33.2 eggs per hen during the year and showing a net loss over feed cost alone of 4 cents per hen for the year. The feed cost of eggs in this pen was 31.9 cents per dozen. The hens fed cottonseed meal also failed to lay many eggs during the winter, and those produced in two of these pens (Nos. 15 and 16) were small (see weight of eggs in Table 5b).

In addition to proving an uneconomical feed, the cottonseed meal affected the appearance and firmness of the eggs, making a considerable percentage of them unmarketable. (See Pl. VII.) Dark-greenish spots of varying sizes were produced on the yolks of the eggs, while the contents in most cases lacked firmness and they would not poach like eggs produced from beef-scrap rations. During warm weather about half of these eggs were classed as unfit for food as judged by appearance, although no disagreeable effects were noted from eating eggs discolored in this manner. During cool and cold weather the quality of these eggs was considerably better than in warm weather.

Comparing the cottonseed pens (Nos. 10 and 15) with those fed about 3.5 per cent of beef scrap in the mash in addition to the cottonseed meal (Nos. 11 and 16), the results were inconsistent, owing at least partly to the fowls mixing. The egg yield in Pens 10 and 11 was about the same, but Pen 16, fed this small amount of beef scrap, laid twice as many eggs as Pen 15, which was without any beef scrap. No material difference was noted in the quality of the eggs from any of the pens. The egg yield and quality of eggs in all these pens were unsatisfactory, and cottonseed meal, either with or without a very small percentage of beef scrap, is not an economical feed for poultry. It is possible that a part (perhaps half) of the beef scrap could be replaced by cottonseed meal to better advantage.

FISH MEAL.

Fish meal, a by-product of the menhaden industry, was used to replace beef scrap in the ration of Pen 13, in comparison with Pen 14, a check pen receiving beef scrap. The mash in Pen 13 contained 20 per cent fish meal, while that of Pen 14 contained the same percentage of beef scrap. (See Table 1.) The fish meal was given an estimated value of $46 per ton, at which price ($7 per ton cheaper than beef scrap) the fish meal proved a good substitute for beef scrap and an economical feed. The protein in the fish meal appeared to be as efficient as that in the beef scrap, considering the relative composition of the feeds.

No abnormal effects were noted in the size, taste, or quality of the eggs from the pen fed fish meal. The fowls in both pens kept in good condition and the mortality was low. Both pens were on free range, but the range of the fish-meal pen was largely in grass while the beef-scrap pen ranged in the woods where there was not any greensward. This difference in range would be slightly in favor of the fish-meal pen. This experiment did not begin until the middle of January, and the egg production in both of these pens was very good for pullets started at that time of the year. Each pen contained 18 pullets.

The egg yield per hen on beef scrap was 160, compared with 145.4 on fish meal, but the latter pen produced eggs at 8.5 cents per dozen, while the eggs from the former pen (beef scrap) cost 9.7 cents. The profit per hen over feed cost was about equal, being 7 cents greater in the beef-scrap pen (see Table 2). The beef scrap was about 6 per cent higher in digestible crude protein than the fish meal (see Table 12), so about one-tenth more fish meal than beef scrap might be fed to advantage in the mash to make the protein content equal. Both fish meal and fish scrap may also be fed with beef scrap with excellent results, replacing about half of the beef scrap with the fish product.

VALUE OF GROUND GRAINS.

Pen 6 was started on a ration (see Table 1) of scratch grains, with beef scrap before the hens all the time. No dry mash of ground grains was fed; the object being to compare the effect and value of the mash in the ration. The hens ate the beef scrap freely, but constant diarrhea developed in the pen, so that it appeared advisable to keep a mixture of equal parts of corn meal and middlings before the hens, which largely checked this evil. The birds were given all the scratch grains they would clean up and ate 16 per cent of mash in 1913, 26 per cent in 1914, and 27 per cent in 1915. The percentage of beef scrap in the total ration in this pen beginning in January, for 4-week periods, was as follows: In 1913: 14, 13, 8, 16, 11, 4, 4, 2, 2, 4, 11, 6, and 6. In 1914: 10, 10, 10, 8, 8, 11, 8, 6, 8, 6, 2, 4, and 8. In 1915: 6, 4, 5, 3, 7, 4, 4, 5, 4, 3, 7, 7, and 5. Barley was fed in this grain mixture (see Table 1).

Pens 5 and 6 were started in January at about the same time and their egg yields the first year were practically equal, but the hens in Pen 6 consumed 6 pounds more of feed per hen, at an additional cost of 17 cents, while it took 0.76 pounds more of feed to produce a dozen eggs, costing 1.94 cents more per dozen. The hens in Pen 6 during their second year ate 10 pounds more of feed than those in Pen 5, costing 17 cents more per hen, while it took 2 pounds more of feed to produce a dozen eggs, costing 3.4 cents more per dozen. In the third year these two pens produced about the same number of eggs, but Pen 5 ate 14 pounds less of grain per hen. Pen 5 produced eggs 2.8 cents per dozen cheaper that year than Pen 6, and the profit per hen over feed cost was 24 cents greater. Pen 6 had the advantage of being on free range, while Pen 5 was confined to yards, and the latter pen contained a much larger number of broody hens than Pen 6. This ration and method of feeding kept the hens too fat (Pen 6), as shown in Table 10. The hens ate the barley freely, and this grain appears to be a good feed to use if cheaper than wheat or to add variety to the ration. However, the comparative value of barley and wheat is not in any way determined by this experiment.

This ration and method of feeding appears to be less desirable than any other in which beef scrap was used. The hens in Pen 6 ate more grain than any other pen, had the highest feed cost, produced eggs at the greatest cost per dozen compared with the other pens started at the same time, and were overfat. Regulating the proportions of mash and scratch grains to about equal parts of each keeps the fowls in better condition than where only a small proportion of mash is fed. Mortality does not appear to be materially influenced by the relative proportions of scratch grains and mash in the ration, if the percentage of beef scrap is not materially changed. A ration including a mash containing beef scrap, or with the beef scrap fed separately, makes a cheaper and better ration than one without the mash, even though the beef scrap is supplied.

FREE RANGE COMPARED WITH LARGE YARDS.

All pens except Nos. 3, 5, and 7 had free range, while these pens were confined to large yards (see Table 1). However, other changes besides the range enter into a comparison of these pens with the range pens, making it hard to draw definite conclusions, but the evidence points strongly to better egg yield and other results on free range, especially with Leghorns. The greatest difference due perhaps to free range is noted in Pen 8, in which during their first year 36 more eggs per hen were laid than in Pen 7, while in their second year the

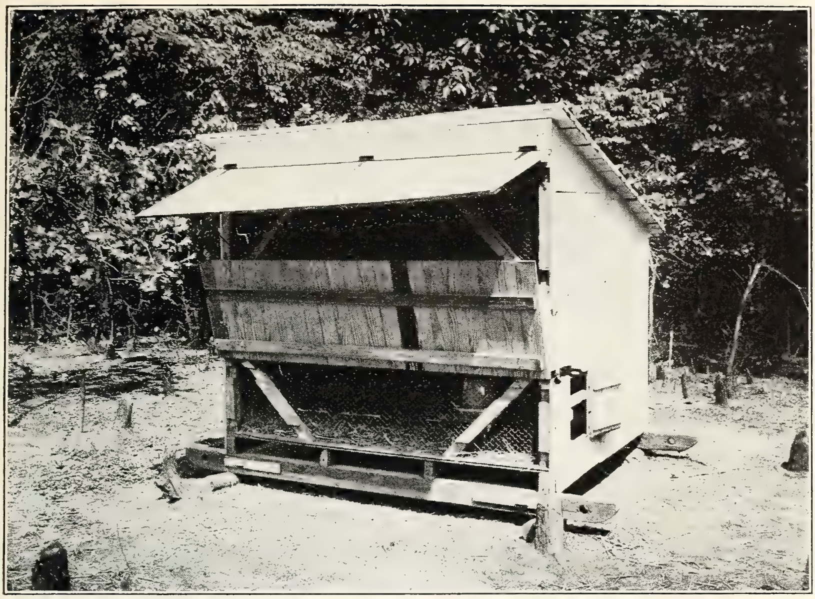


FIG. 1.—COLONY GROWING HOUSE USED AT GOVERNMENT POULTRY FARM, BELTSVILLE, MD.

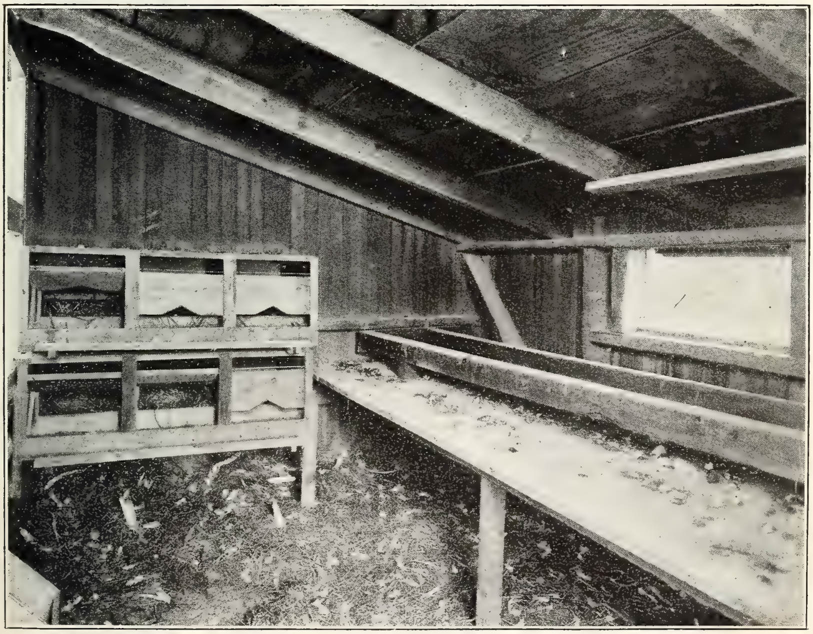


FIG. 2.—INTERIOR OF COLONY HOUSE SHOWN IN PLATE III.

Showing litter on floor, dropping boards, roosts, and nests.

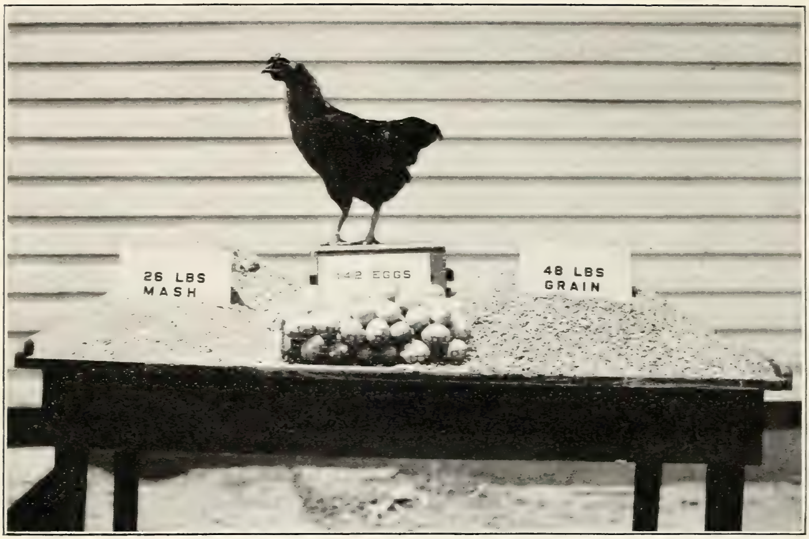


FIG. 1.—AVERAGE RESULTS IN PEN 1 (RHODE ISLAND REDS) DURING PULLET YEAR.

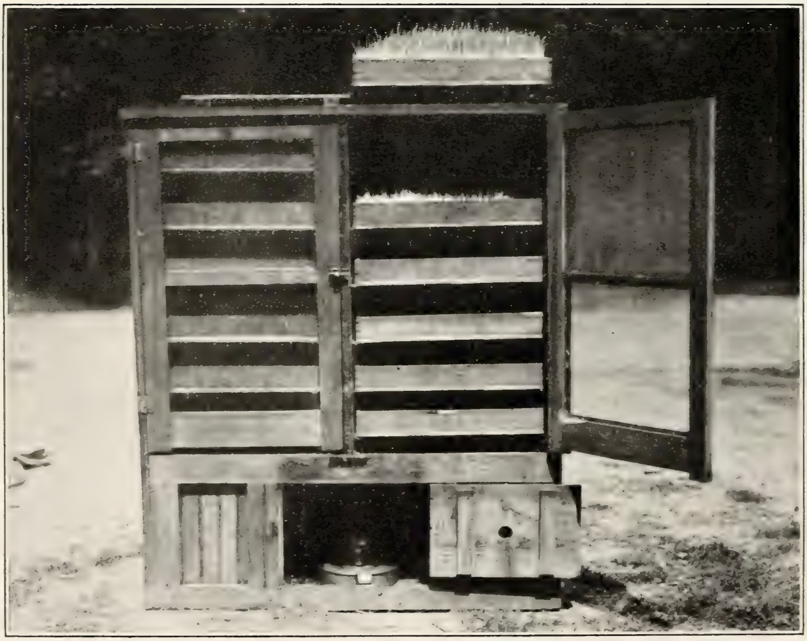


FIG. 2.—OATS SPROUTER. ONE TRAY OF OATS ON TOP OF CASE READY TO BE FED.

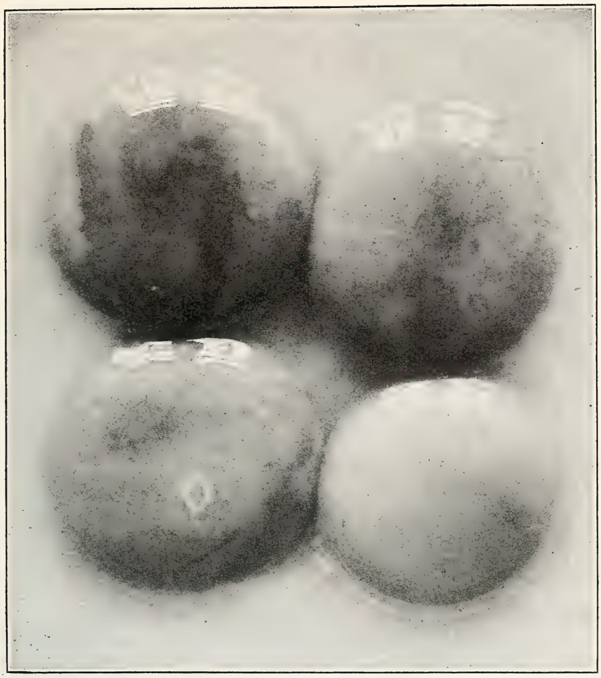


FIG. 1.—EGGS FROM PEN 15, SHOWING EFFECT OF SMALL PERCENTAGE OF COTTONSEED MEAL IN RATION.

Normal egg in lower left-hand corner.

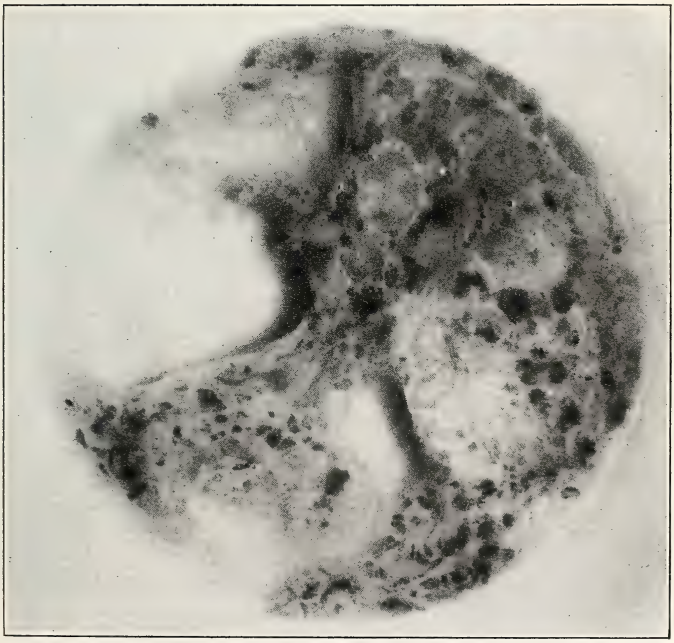


FIG. 2.—EGG SIMILAR TO THOSE IN UPPER PICTURE, WITH YOLK BROKEN OPEN.

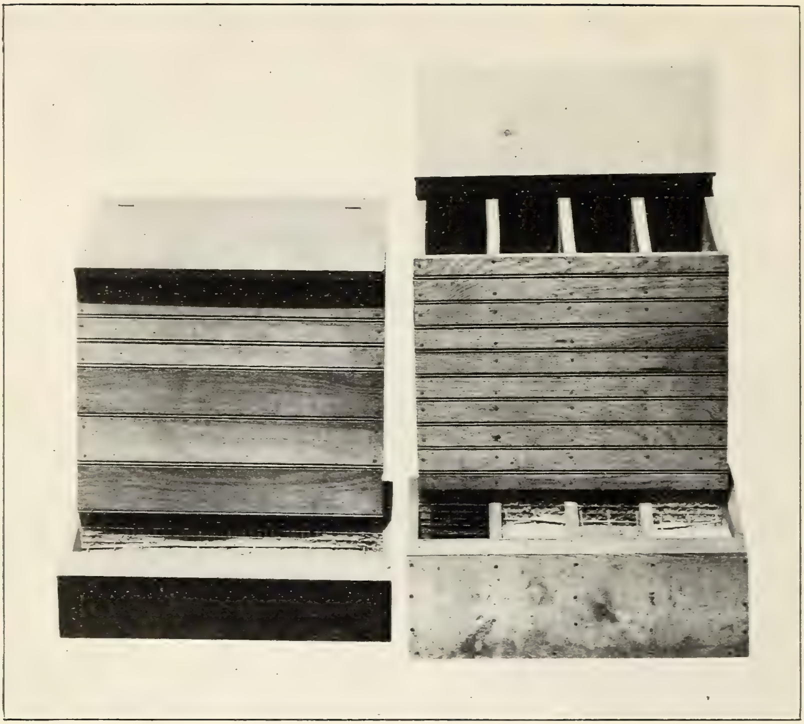


FIG. 1.—DRY-MASH HOPPERS.

The hopper on the right has separate compartments, and was used in pens 3, 4, and 7.

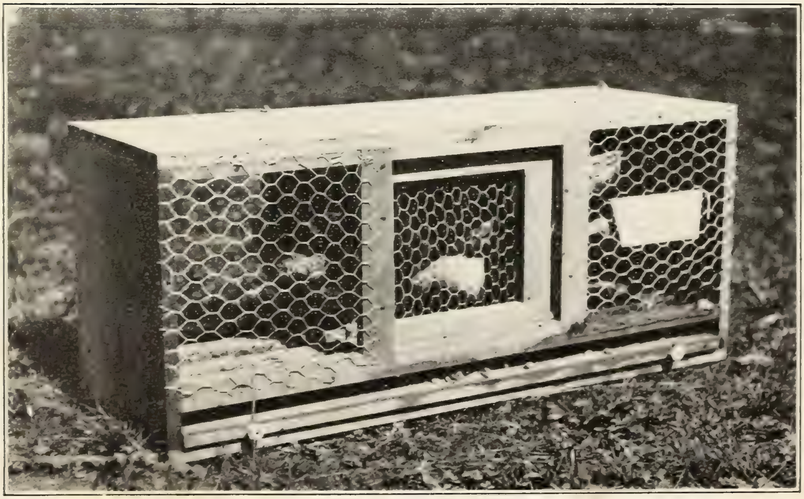


FIG. 2.—COOP FOR BROODY HENS.

This coop is hooked to the inside wall of the house, above the nests.

difference was 45 eggs per hen in favor of free range. These two pens of Leghorns are apparently fairly comparable, as they are of similar breeding, they were reared under similar conditions, were started at the same time, and received almost similar rations except that in Pen 7 the mash constituents were separate while they were mixed together in Pen 8. This difference in the method of feeding, as previously discussed, does not appear to be a material factor in affecting the egg yield. Pen 8, however, received 4 per cent more beef scrap than Pen 7 in 1914, and 16 per cent more in 1915, which is a very material factor. A comparison of Pen 4, which was on free range, with Pen 7 (confined) appears to strengthen the conclusion that free range materially increases egg yield, as the percentage of beef scrap consumed in these pens was more nearly equal. The Leghorns ranged over a wide area, while the general-purpose breeds neither kept as busy scratching nor ranged over nearly as much ground.

The use of yards does not appear to affect the mortality among the fowls for a period of one or two years (see Table 2). The loss in the confined pens was in several instances considerably less than in the pens on free range, but part of the additional loss on free range was caused by hawks and missing fowls. The greatest mortality occurred in the pens giving the highest egg production, and it would appear that this difference in egg production, rather than free range, was the material factor in causing the difference in mortality in Pens 7 and 8. It would not appear that free range of itself, except for the loss caused by hawks or other marauders, increased the mortality. Free range did not lower the total consumption of grain nor decrease the cost of feeding, except for the green feed which was supplied to the pens confined to yards. On the whole the consumption of grain was greater with the pens on range, owing to the greater production in these pens. The cost of the dry oats used for green feed (sprouted oats) per hen averaged about 10 cents per year. A study of all these pens appears to show that free range very materially increases the egg yield in Leghorns, and somewhat, but to a considerably less extent, in the general-purpose breeds.

YARDS AND GREEN FEED.

Pens 3 and 5 each had a large yard containing about 220 square feet of land per fowl and were kept in this yard about one year. They were then moved to a similar yard and the old yard was plowed and planted to grass, clover, and oats. The present plan is to alternate these yards once yearly, plowing and seeding the ground not in use, and thus keep the soil sweet as well as to provide some green feed. The soil in these yards is a heavy clay, parts of which are poorly drained and not well adapted for a permanent greensward. The yards contained only a small amount of grass and weeds when the fowls were first put into them. Two yards for each pen allows about 440 square feet of ground per fowl, which is at the rate of about 100 hens to the acre. Pen 7 was confined to a single yard, which was plowed and planted after the hens had been in the yard about 9 months. The hens were confined by a temporary fence to a space of about one-tenth of the entire yard for 4 weeks until the oats were well started. This pen has a yard space of 218 square feet per hen, or about 200 hens to an acre. A single yard handled in this manner does not provide a good yarding system for poultry on heavy clay land. The growing grain and grass is all killed within a few weeks, and the yard is entirely bare the rest of the year.

No green feed was supplied to the pens on free range, but sprouted oats were fed at noon daily to those confined to yards (Pens 3, 5, and 7). Pens 3 and 5 were fed some cabbages during their first winter (1912 to 1913), but did not receive green feed regularly until March, 1913, when the sprouted oats secured from half a pound of dry oats were fed daily. The amount of dry oats per pen was increased at the beginning of 1914 to 0.6 of a pound (about 1½ square inches of sprouted oats daily per hen) and fed to Pens 3, 5, and 7. The cost of green feed in 1912 to 1913 per dozen eggs in Pens 3 and 5 was 0.8 and 0.9 cents, respectively. The cost per hen was 8.7 cents in Pen 3 and 9 cents in Pen 5. The cost of the green feed includes only the cost of the cabbages used in 1912 and 1913 and the cost of the dry oats for the rest of the time. In 1913 and 1914 the cost per dozen eggs in Pens 3, 5, and 7 was 1.8, 1.5, and 1 cents, respectively, and the cost per hen was 11.4 cents in Pen 3, 11.7 cents in Pen 5, and 10 cents in Pen 7. This cost was proportionately greater in 1915, as the same quantity of oats was fed to each pen, while the number of hens had decreased slightly, and the egg yield had decreased materially. Thus the green feed increased the cost of feeding the hens about 10 cents each, and during their first two years added a little over 1 cent per dozen to the cost of the eggs.

CONSUMPTION OF GRIT AND OYSTER SHELL.

The hens in 1912 to 1913 were fed about 1.3 pounds each of grit and oyster shell, which cost about 1.6 cents per hen. In 1913 to 1914 the hens were fed about the same amount of oyster shell but only about one-third as much grit, reducing the cost to about 1 cent per hen. During the third laying year, as egg production decreased the hens consumed considerably less grit and oyster shell. The consumption was slightly greater in Pens 9 and 10, where no beef scrap was fed, than in the beef-scrap pens. Pens 10 to 16 ate on the average in one year from 0.5 to 1 pound of grit per hen and from 1.5 to 2.5 pounds of oyster shell.

LEGHORNS COMPARED WITH GENERAL-PURPOSE BREEDS.

Leghorns produce eggs cheaper than hens of the general-purpose breeds (Plymouth Rocks, Wyandottes, Rhode Island Reds, and Orpingtons), because they lay as many or more eggs, eat only about 55 pounds of feed per head annually compared with from 70 to 85 pounds eaten by general-purpose breeds, and their egg yield very materially exceeds that of the general-purpose breeds during their second and third laying years (see Table 2). The feed cost of a dozen eggs for Pen 4 (Leghorns) was 7.34 cents in 1913, while the average cost of all the general-purpose breeds was 10.6 cents. In 1914 the feed cost of a dozen eggs for Pen 4 was 8.7 cents as against an average cost of 15.1 cents for the second laying year of the general-purpose pens. During their third laying year the cost of a dozen eggs was 8.8 cents for the Leghorns compared with 18.6 cents for the general-purpose fowls (Pens 5 and 6). The total profit per hen over feed cost in Pen 4 (Leghorns) for three years was $6.84 against $4.30 for Pens 5 and 6 (general-purpose fowls). Pen 8 (Leghorns) in 1914 laid 157.6 eggs per hen, the highest egg production secured in any of the feeding experiments up to 1915, producing eggs at a feed cost of 6.7 cents a dozen. Pen 12 composed of general-purpose fowls and crosses containing some Leghorn blood, laid 169.5 eggs per hen in 1915. The amount of grain eaten was large, however, making the feed cost of a dozen eggs 10.2 cents. The cost in Pen 2 during its first year was 7.74 cents, which was the lowest cost of any of the general-purpose pens. The average cost of eggs in Pens 7 and 8 (Leghorns) in 1914 (their first year) was 7.7 cents. For the first two years the average annual feed cost for Leghorns was about 88 cents and for the general-purpose breeds $1.13.

The Leghorns produced smaller eggs than the general-purpose breeds. The average weight of the eggs in Pen 4 (Leghorns) during the first laying year weighed 1.42 pounds per dozen, as against 1.53 to 1.58 pounds for the other pens. (See Table 5.) However, Leghorns laying eggs weighing 1.50 pounds per dozen or over have been selected and bred by many poultrymen. An examination of 500 eggs from the Leghorn pens (Nos. 4, 7, and 8) made the first of May, 1915, showed that 31 per cent weighed over 2 ounces apiece, or 1.5 pounds to the dozen. The percentages and weights of these eggs were as follows: Eight per cent under 1¾ ounces, 26 per cent from 1¾ up to (not including) 1⅞ ounce, 35 per cent from 1⅞ to 2 ounces, 23 per cent from 2 to 2⅛ ounces, and 8 per cent over 2⅛ ounces.

The Leghorns in Pen 4 increased less than one-half pound in weight from the beginning of the experiment, January, 1913, until January, 1915, while the general-purpose breeds (Pens 5 and 6) increased a little over a pound during the same period. (See Table 10.) The

Leghorns increased about one-fifth of a pound in weight during their third year while the general-purpose pens increased one-third of a pound. In comparing the market value of the fowls this extra weight should be credited to the general-purpose fowls. The Leghorns do not tend to become overfat during their second and third laying years as do most of the general-purpose breeds.

The value per dozen of the eggs produced by the Leghorns (Pens 4, 7, and 8) was from 1 to 3 cents less each year than that of the general-purpose pens. (See Table 9.) This difference in value is due to the fact that the general-purpose breeds are better winter layers than the Leghorns, while the latter give a higher production in the spring and summer. This difference is more marked in the second than in the first or third years, as shown in Table 6, where Pens 7 and 8 (Leghorns) laid nearly as well during their first winter as the general-purpose pens (Nos. 1, 2 and 3), although the average value of the eggs per dozen for the year was slightly less in the Leghorn pens. Very few Leghorns become broody, which probably materially affects their egg yield as compared with the general-purpose breeds (see page 35). Better fertility in the eggs, especially with stock confined to yards, is more often secured from Leghorns than from the general-purpose or from any of the heavier breeds. No experiments have been conducted on the fertility and hatchability of the eggs from any of these feeding pens, but eggs have been hatched from several of them and no marked differences due to the feeding or method of management have been noted. Summing up these comparisons, the Leghorns are undoubtedly more profitable fowls to keep for the production of eggs only than are the general-purpose breeds, which confirms the belief and experience of commercial poultry farmers producing eggs for market.

EGG YIELD AS AFFECTED BY TIME OF MATURITY AND AGE OF FOWLS.

The average decrease in egg production of all the general-purpose breeds during their second year was 42.4 eggs, or about 32 per cent, while the decrease in the Leghorns (Pen 4) was only 21.9 eggs, or about 16 per cent. The decrease in all general-purpose pens from the second to third year production was about 16 per cent. The decrease in Pen 4 (Leghorns) was only 4 per cent. However, the decrease in Pens 5 and 6, which were started at the same time as Pen 4, was only 20 per cent during their second year and 13 per cent during their third year, as discussed later in this paragraph. The time of maturity affects this question materially, as the fowls which began to lay in November (Pens 1, 2, and 3) laid 17.8 more eggs per hen during their first year than Pens 5 and 6, which began to lay in January. On the other hand, Pens 1, 2, and 3 (early maturing) laid 40 per cent less their second than during their first year, while Pens 5 and 6 (late maturing) laid only 20 per cent less. During their third year the egg production decreased 20 per cent in the early-maturing against 13 per cent in the late maturing pens. The fowls in this experiment, which matured late laid later in the season in both their first and second laying years, and while the value of their eggs was less the first year than that of the early maturing fowls, it was greater in their second year, largely because they laid a larger percentage of their eggs later in the season when the value per dozen is greater. The average yearly egg production (110.2 eggs) for two years of the general-purpose pens (Nos. 1, 2, and 3), which started to lay in November exceeds the average yearly production (107.7) of Pens 5 and 6 by only 2.5 eggs. (See Table 2.) The average three-year production for the early maturing pens (Nos. 1, 2, and 3) was 94.7 eggs against 99.5 in the late maturing pens (Nos. 5 and 6).

The average yearly value per hen of the eggs in Pens 1, 2, and 3, for two years was $3.06 against $2.97 in Pens 5 and 6; for three years the averages were $2.55 and $2.69, respectively. In other words, the value of the eggs for two years from the hens which started to lay early slightly exceeded the value of those which started to lay late, while for three years the value of eggs from the late-hatched pens exceeded that of the early hatched pens by 14 cents per hen. Comparing the yearly average for two years of Pen 4 (Leghorns) with Pens 5 and 6 (general purpose) all of which were late-maturing pens, the former averaged 126.8 while the latter averaged 107.7, or 19.1 eggs less. For three years the Leghorns averaged 121.9 eggs against 99.5 eggs in Pens 5 and 6. The yearly average value for two years of the eggs from Pen 4 was $3.25 against $2.92 from Pens 5 and 6. The average for three years was $3.09 in Pen 4 against $2.65 in Pens 5 and 6. The yearly average yield of all the general-purpose breeds was 109.3 eggs for two years and 71.4 for three years.

WEIGHT OF EGGS.

The average weight of eggs during each 4-week period throughout the year is shown in Tables 5, 5a, and 5b, with the pens arranged so that the dates of the periods correspond as nearly as possible.

TABLE 5.—*Weight of eggs per dozen, by 4-week periods, 1912–13.*

Period.	First laying year.					
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.
1912.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
November	1.52	1.47	1.46	....	....	....
December	1.48	1.51	1.50	....	....	....
1913.						
January	1.55	1.52	1.51	....	....	....
February	1.56	1.54	1.54	1.41	1.52	1.49
March	1.64	1.57	1.52	1.43	1.63	1.58
April	1.66	1.60	1.52	1.42	1.57	1.53
May	1.60	1.57	1.59	1.41	1.52	1.50
May	1.62	1.61	1.58	1.38	1.52	1.54
June	1.53	1.50	1.61	1.43	1.50	1.51
July	1.51	1.55	1.58	1.40	1.48	1.51
August	1.53	1.55	1.59	1.43	1.52	1.62
September	1.56	1.61	1.58	1.48	1.60	1.70
October	1.57	1.48	1.52	1.49	1.59	1.49
November	(1.47)	(1.53)	(1.55)	1.35	1.50	1.50
December	(1.39)	(1.41)	(1.46)	1.36	1.48	1.50
1914.						
January	(1.47)	(1.43)	(1.46)	1.31	1.49	1.49
Average	1.58	1.55	1.54	1.42	1.54	1.53

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May see note under Table 4.

TABLE 5a.—*Weight of eggs per dozen, by 4-week periods, 1913–14.*

Period.	Second laying year.						First laying year.		
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.	Pen 8.	Pen 9.
1913.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
November	1.47	1.53	1.55	(1.35)	(1.50)	(1.50)	....	....	....
December	1.39	1.41	1.46	(1.36)	(1.48)	(1.50)	1.36	1.40	1.45
1914.									
January	1.47	1.43	1.46	(1.31)	(1.49)	(1.49)	1.41	1.32	1.48
February	1.68	1.49	1.62	1.49	1.57	1.58	1.43	1.42	1.51
March	1.68	1.60	1.65	1.53	1.58	1.58	1.49	1.48	1.48
April	1.67	1.64	1.65	1.52	1.60	1.64	1.48	1.51	1.51
May	1.74	1.69	1.65	1.56	1.59	1.71	1.53	1.54	1.54
May	1.65	1.65	1.62	1.50	1.59	1.61	1.44	1.45	1.50
June	1.60	1.61	1.59	1.46	1.60	1.54	1.43	1.45	1.46
July	1.63	1.57	1.63	1.47	1.60	1.58	1.51	1.42	1.43
August	1.62	1.58	1.63	1.47	1.58	1.64	1.45	1.48	1.44
September	1.71	1.60	1.60	1.47	1.58	1.59	1.52	1.54	1.50
October	1.78	1.61	1.66	1.54	1.65	1.62	1.54	1.56	1.56
November	(1.47)	(1.65)	(1.50)	1.60	1.71	1.74	1.61	1.54	1.54
December	....	(1.68)	(1.58)	....	1.80	....	(1.55)	(1.59)	(1.58)
1915.									
January	....	....	(1.70)	....	....	1.61	(1.50)	(1.61)	(1.63)
Average	1.65	1.59	1.62	1.50	1.60	1.62	1.46	1.47	1.50

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May see note under Table 4.

TABLE 5b.—*Weight of eggs per dozen by 4-week periods, 1914–15.*

Period.	Third laying year.						Second laying year.		
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.	Pen 8.	Pen 9.
1914.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
November	1.47	1.65	1.50	(1.60)	(1.71)	(1.74)	(1.61)	(1.54)	(1.54)
December	....	1.68	1.58	....	(1.80)	....	1.55	1.59	1.58
1915.									
January	....	....	1.70	....	....	(1.61)	1.53	1.61	1.63
February	1.90	1.69	1.71	1.56	1.76	1.64	1.52	1.60	1.62
March	1.82	1.70	1.70	1.50	1.69	1.67	1.51	1.57	1.59
April	1.84	1.70	1.51	1.49	1.65	1.64	1.46	1.55	1.59
May	1.73	1.64	1.61	1.50	1.65	1.60	1.45	1.51	1.56
May	1.70	1.61	1.61	1.50	1.55	1.62	1.41	1.49	1.55
June	1.65	1.70	1.63	1.46	1.60	1.65	1.46	1.47	1.53
July	1.71	1.53	1.63	1.48	1.60	1.62	1.44	1.46	1.51
August	1.74	1.66	1.58	1.48	1.64	1.61	1.45	1.50	1.52
September	1.82	1.35	1.60	1.48	1.64	1.60	1.47	1.53	1.48
October	....	....	....	....	1.75	....	1.56	....	1.67
November	....	....	....	....	1.55	1.62	....	....	....
Average	1.75	1.66	1.61	1.49	1.63	1.62	1.46	1.52	1.56

Period.	First laying year.						
	Pen 10.	Pen 11.	Pen 12.	Pen 13.	Pen 14.	Pen 15.	Pen 16.
1914.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
November	....	....	1.44	....	....	....	....
December	1.30	1.45	1.44	....	....	....	....
1915.							
January	....	1.64	1.51	....	....	....	....
February	1.65	1.73	1.57	1.46	1.48	....	....
March	1.59	1.72	1.62	1.53	1.55	1.49	1.49
April	1.51	1.55	1.56	1.50	1.47	1.38	1.39
May	1.49	1.51	1.53	1.53	1.45	1.41	1.50
May	1.62	1.57	1.53	1.54	1.49	1.36	1.41
June	1.59	1.50	1.57	1.49	1.47	1.36	1.46
July	1.68	1.48	1.55	1.49	1.46	1.20	1.44
August	1.57	1.61	1.54	1.53	1.49	....	1.44
September	1.70	1.51	1.43	1.55	1.46	....	1.59
October	1.74	....	1.61	1.67	1.55	....	....
November	....	....	....	1.65	1.54	....	....
December	....	....	....	....	....	1.32	....
1916.							
January	....	....	....	1.48	1.45	....	....
February	....	....	....	....	....	1.44	....
Average	1.59	1.56	1.54	1.51	1.47	1.37	1.45

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May see note under Table 4.

The average weight of the eggs is highest in the early spring months, with a gradual decrease in weight to the period of lowest averages, which occur during the summer months. The average weight of a dozen eggs for Pens 1 to 6 was 1.53 pounds during the first year (1912 to 1913), 1.60 pounds for the second year, and 1.63 pounds during the third year. The production of larger eggs during the early spring months and during the second and third as compared with the first year is thought to account in part for the larger and stronger chickens which are said to be procured during the early spring months and from mature stock. It is not apparent that the different rations affected the weight of the eggs except in Pens 9 and 15, where no beef scrap was fed, and in Pen 16, which had only a very small percentage of beef scrap. The eggs from Pen 9 were smaller throughout the year than from the other general-purpose pens during their first laying year, and averaged 0.05 of a pound less per dozen with a similar difference in weight during their second year. The eggs in Pens 15 and 16 were very small. These pens were fed on a ration containing cottonseed meal and the hens did not eat enough feed to produce normal results. This feature is discussed more in detail on page 13. The increased size of the Leghorn eggs from Pens 7 and 8 in 1914, compared with Pen 4 in 1913, goes with the increased weight of the fowls as shown in Table 10, and may be due to the introduction of new blood and to the selection of larger fowls for breeding. The eggs in Pen 8 on free range weighed about the same as those from Pen 7 confined during their first year, but were 0.06 of a pound per dozen heavier in their second year, apparently owing to free range and a greater percentage of beef scrap in the ration.

The average weight of the eggs during the period of low production (fall and early winter) is subject to error during the first two years' work, as it may have been greatly affected by a few individual hens or by the cumulative error in reading the weight of only one or two eggs. To eliminate this latter error during the period of low production the eggs were held until six had accumulated before being weighed in the succeeding experiments. When the egg production during a four-week period is less than 36 eggs no weight is calculated for that period, which accounts for the blanks in Tables 5, 5a, and 5b.

DISTRIBUTION OF EGG PRODUCTION.

Tables 6, 6a, and 6b show the percentage of egg production for 13 periods of 4 weeks in each year for all pens. This is calculated on the basis of the maximum, or 100 per cent, being equal to one egg per hen per day. The average percentage of production for two and for three years are also given. The periods are arranged to make them correspond as nearly as possible in each pen. The exact periods for each pen are given on page 8.

TABLE 6.—*Percentage of egg production for 4-week periods, 1912–13.*

100 PER CENT=1 EGG PER HEN PER DAY.

Period.	First laying year.					
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.
1912.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
November	36	29	16			
December	27	38	42			
1913.						
January	18	34	43			
February	42	45	44	43	34	26
March	56	51	55	63	54	48
April	58	61	50	75	58	59
May	58	50	49	70	51	57
May	52	49	39	57	42	44
June	42	43	28	46	42	43
July	39	31	29	42	30	33
August	38	35	20	32	30	28
September	25	33	24	26	25	18
October	15	20	11	14	21	13
November	(3)	(9)	(9)	7	13	17
December	(6)	(7)	(10)	6	14	20
1914.						
January	(7)	(7)	(8)	12	20	15
Average	39	40	34	38	33	30

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May see note under Table 4.

TABLE 6a.—*Percentage of egg production for 4-week periods, 1913–14.*

100 PER CENT=1 EGG PER HEN PER DAY.

Period.	Second laying year.						First laying year.		
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.	Pen 8.	Pen 9.
1913.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
November	3	9	9	(7)	(13)	(17)			
December	6	7	10	(6)	(14)	(20)	37	28	9
1914.									
January	7	7	8	(12)	(20)	(15)	31	35	8
February	26	11	21	41	25	21	36	43	29
March	27	22	26	29	36	36	39	57	10
April	48	40	37	58	51	44	44	70	46
May	38	43	34	68	45	45	59	73	44
May	47	24	31	63	35	27	52	62	38
June	37	31	26	49	34	43	46	59	30
July	28	29	19	44	28	32	21	43	27
August	26	26	20	30	34	27	29	24	23
September	23	22	20	19	28	19	14	25	21
October	13	7	16	11	23	15	14	27	19
November	(1)	(1)	(7)	0	14	8	9	19	16
December	(0)	(1)	(2)	0	2	0	(9)	(8)	(9)
1915.									
January	(2)	(1)	(3)	0	0	7	(19)	(21)	(7)
Average	25	21	21	32	27	25	33	43	25
2-year average	32	30.5	27.5	35	30	27.5			

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May see note under Table 4.

TABLE 6b.—*Percentage of egg production for 4-week periods, 1914–15.*

100 PER CENT=1 EGG PER HEN PER DAY.

Period.	Third laying year.						Second laying year.		
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.	Pen 8.	Pen 9.
1914.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
November	1	1	7	(0)	(14)	(8)	(9)	(19)	(16)
December	0	1	2	(0)	(2)	(0)	9	8	9
1915.									
January	2	1	3	(0)	(0)	(7)	19	21	7
February	9	6	11	16	21	27	27	40	20
March	34	26	22	36	36	35	40	64	32
April	39	41	26	52	46	45	46	71	38
May	33	36	28	68	36	46	47	73	45
May	36	28	35	62	35	44	45	73	42
June	29	26	22	62	37	27	44	65	34
July	33	19	27	45	28	25	39	57	24
August	24	20	15	32	25	19	33	41	21
September	15	7	10	17	15	12	24	23	15
October	0	1	4	2	9	3	8	3	10
November	....	....	....	0	7	7	1	2	0
December	....	....	....	0	0	2	....	....	....
1916.									
January	....	....	....	7	1	6	....	....	....
February	....	....	....	....	....	....	....	....	....
Average	20	16	16	31	23	23	29	42	23
3-year average	28	26	24	34	28	26	[1] 31	[1] 43	[1] 24

Period.	First laying year.						
	Pen 10.	Pen 11.	Pen 12.	Pen 13.	Pen 14.	Pen 15.	Pen 16.
1914.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
November	0	0	7	....	....	....	....
December	2	3	24	....	....	....	....
1915.							
January	0	16	39	....	....	....	....
February	17	20	66	31	35	....	....
March	33	29	60	63	65	10	17
April	40	37	70	67	67	17	25
May	55	47	68	59	69	25	44
May	54	49	61	48	67	17	39
June	41	49	62	48	59	13	34
July	40	46	49	42	53	2	23
August	35	42	41	45	43	3	20
September	28	23	38	38	39	4	12
October	26	5	20	30	34	0	5
November	....	....	....	27	25	2	0
December	....	....	....	7	7	10	2
1916.							
January	....	....	....	13	8	4	8
February	....	....	....	....	....	11	12
Average	29	29	46	40	44	9	19
3-year average	....	....	....	....	....	....	....

[1] Two-year average.

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May see note under Table 4.

The fall and early winter eggs were largely secured from the pullets, as the production of the yearling hens during these months was very low. The total egg yield of all periods throughout the year is less during the second year, although this difference is neither as large in the Leghorns (Pens 4 and 8) as in the general-purpose breeds (Pens 1, 2, 3, 5, and 6), nor in the late-hatched (Pens 4, 5, and 6) as in the early-hatched (Pens 1, 2, and 3). Spring is the period of greatest total production. Pen 4 (Leghorns) shows considerably less production during the fall and early winter of their second laying year than was the case with the general-purpose pens, especially Pens 5 and 6, started at the same time as Pen 4. Pens 7 and 8 (Leghorns) also show a slightly decreased production during their second winter period, although not as great a decrease as in Pen 4. This difference is also seen in the comparative feed cost of the eggs, shown in Table 7.

The effect of snow on the ground in lowering the egg yield during their first winter was noticeable in Pen 9, which did not receive any beef scrap. However, the egg yield the second winter in this pen compares favorably with that of Pens 1, 2, and 3 during their second winter. The lack of beef scrap as affecting egg production is discussed more in detail on page 11. The weather during February, 1914, was quite mild with practically no snow, while March was cold with considerable snow. Lack of beef scrap also lowered the production throughout the entire year. None of the other differences in the rations appeared to affect the distribution of egg production materially.

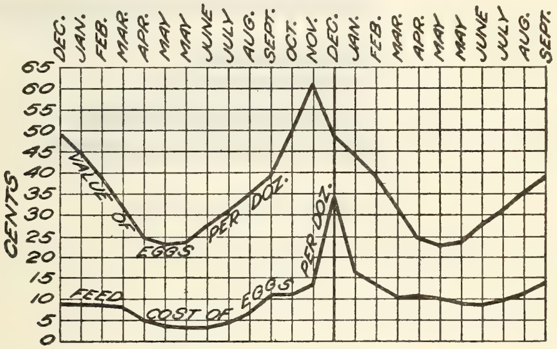


FIG. 3.—Feed cost and value of eggs per dozen in Pen 8.) Last two periods of second year are omitted, as hens had stopped laying.)

FEED COST OF EGGS.

The feed cost of a dozen eggs for periods of four weeks each throughout the three years of these experiments is shown in Tables 7, 7a, and 7b. Prices of individual grains in 1917 are from 20 to 100 per cent higher than the prices used in this bulletin. Present prices of grain should be compared to those quoted on page 6 in arriving at the present feed cost of producing eggs. This cost is directly proportional to the egg yield as given in Tables 6, 6a, and 6b. Eggs are produced at the lowest cost in the spring and at the highest cost in the fall and early winter. This high cost in the fall and winter increases very materially with the age of the fowls. Figure 3 shows the feed cost and value of eggs per dozen in Pen 8 over a period of two years. The feed cost during the first year is fairly constant, but becomes more variable after this period. Figure 4 shows annual comparisons of the Leghorns and general-purpose breeds, also the effect of certain feeds.

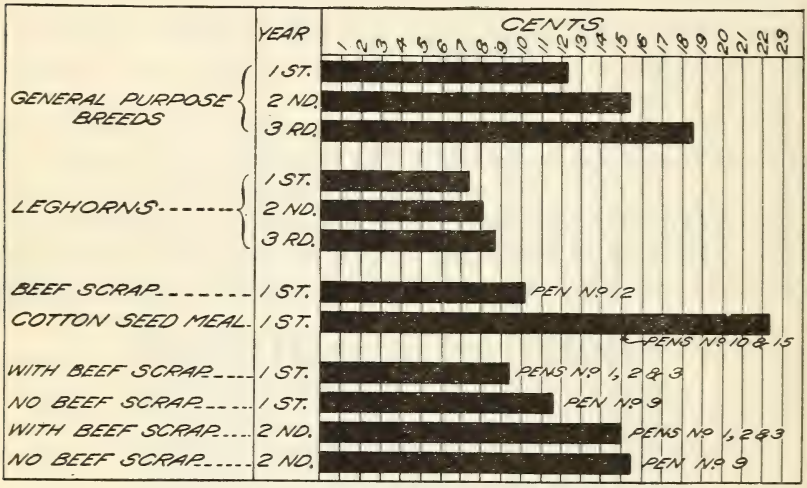


FIG. 4.—Average feed cost of egg production.

TABLE 7.—*Feed cost per dozen eggs for 4-week periods, 1912–13.*

Period.	First laying year.					
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.
1912.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
November	11.3	13.5	28.2	....	....	....
December	14.7	10.5	10.7	....	....	....
1913.						
January	29.5	11.7	11.5	....	....	....
February	11.6	6.6	11.3	7.9	13.7	18.8
March	9.2	7.5	8.5	6.1	10.4	12.0
April	7.8	6.0	7.4	4.4	8.1	8.1
May	6.5	5.4	7.6	4.1	7.4	7.7
May	6.2	5.1	7.6	4.5	8.9	8.9
June	6.6	5.6	8.5	5.0	6.5	8.1
July	7.7	7.9	11.1	7.1	9.2	11.8
August	7.5	7.4	14.7	7.4	10.5	12.5
September	14.1	8.1	15.3	9.9	13.3	19.7
October	19.8	13.1	31.5	18.1	15.2	28.1
November	(102.0)	(22.9)	(35.0)	41.0	26.7	28.7
December	(70.0)	(44.4)	(38.1)	41.1	29.9	23.8
1914.						
January	(55.0)	(51.3)	(45.4)	26.3	19.1	31.9
Average	9.9	7.7	10.9	7.3	11.2	13.2

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May see note under Table 4.

Table 7a.—*Feed cost per dozen eggs for 4-week periods, 1913–14.*

Period.	Second laying year.						First laying year.		
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.	Pen 8.	Pen 9.
1913.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
November	102.0	22.9	35.0	(41.0)	(26.7)	(28.7)	....	....	....
December	70.0	44.4	38.1	(41.1)	(29.9)	(23.8)	7.2	9.3	28.6
1914.									
January	55.0	51.3	45.4	(26.3)	(19.1)	(31.9)	11.0	9.5	40.0
February	12.0	33.7	17.2	6.9	15.8	21.0	10.4	8.0	10.4
March	14.0	15.7	12.8	11.1	11.5	13.8	9.3	7.1	32.6
April	7.0	7.8	10.1	5.5	8.5	11.4	6.6	4.6	5.4
May	7.5	7.8	9.9	5.0	7.9	8.3	5.2	4.6	6.3
May	6.8	10.0	10.2	4.5	8.8	11.9	5.4	4.0	6.3
June	9.0	10.0	13.5	5.2	9.5	9.3	5.6	4.3	8.9
July	10.3	9.8	15.5	6.4	10.6	14.2	10.8	5.0	9.4
August	11.1	11.9	14.7	8.1	9.8	12.6	8.1	7.1	11.5
September	16.0	16.2	17.7	12.3	11.2	20.4	18.1	12.0	14.5
October	41.8	52.4	22.0	23.8	19.6	30.7	22.4	11.1	18.0
November	(246.0)	(560.0)	(40.2)	645.0	27.6	55.5	30.2	14.7	22.8
December	....	(290.0)	(175.0)	....	160.0	210.0	(29.8)	(33.1)	(38.2)
1915.									
January	(150.0)	(360.0)	(90.0)	390.0	200.0	92.1	(14.5)	(16.5)	(57.0)
Average	14.4	14.6	16.0	8.7	13.5	16.9	8.7	6.7	11.7

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May see note under Table 4.

Table 7b.—*Feed cost per dozen eggs for 4-week periods, 1914–15.*

Period.	Third laying year.						Second laying year.		
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.	Pen 8.	Pen 9.
1914.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
November	246.0	560.0	40.2	(645.0)	(27.6)	(55.5)	(30.2)	(14.7)	(22.8)
December	....	290.0	175.0	....	(160.0)	(210.0)	29.8	33.1	38.2
1915.									
January	150.0	360.0	90.0	(390.0)	(200.0)	(92.1)	14.5	16.5	57.0
February	53.6	83.0	37.1	17.9	22.4	22.9	11.4	8.1	19.0
March	14.0	17.0	12.7	7.8	12.7	14.5	7.3	5.3	9.6
April	11.2	9.9	10.3	4.9	9.8	11.9	6.1	5.4	10.0
May	10.8	9.5	9.5	4.8	11.2	10.0	5.6	5.1	8.1
May	12.8	14.7	8.4	5.3	11.2	9.8	6.3	4.7	8.8
June	14.0	12.7	12.4	5.2	9.9	13.3	6.3	4.5	8.3
July	14.0	22.3	11.2	6.4	14.6	18.6	7.0	5.0	13.8
August	19.2	17.2	19.9	7.4	17.0	20.9	9.8	6.9	17.0
September	25.0	38.7	28.1	11.4	21.9	27.5	11.1	9.7	23.3
October	....	730.0	83.5	133.0	32.4	138.4	27.6	92.3	32.6
November	....	....	....	....	45.7	64.4	247.0	190.0	92.3
December	....	....	....	....	910.0	256.0	....	....	....
1916.									
January	....	....	....	40.0	340.0	91.0	....	....	....
February	....	....	....	....	....	....	....	....	....
Average	22.4	26.0	19.5	8.8	17.2	20.0	9.4	7.5	15.3

TABLE 7b.—*Feed cost per dozen eggs for 4-week periods, 1914–15*—Continued.

Period.	First laying year.						
	Pen 10.	Pen 11.	Pen 12.	Pen 13.	Pen 14.	Pen 15.	Pen 16.
1914.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
November	....	....	45.7	....	....	....	....
December	159.0	70.8	17.1	....	....	....	....
1915.							
January	....	20.0	12.1	....	....	....	....
February	22.4	15.4	8.1	12.7	10.8	....	....
March	10.0	10.6	9.9	7.3	7.2	31.0	18.6
April	8.1	7.9	8.8	6.7	7.0	14.3	10.4
May	6.9	6.7	7.8	5.7	7.1	9.1	6.7
May	8.7	7.7	8.3	6.1	7.2	15.7	7.1
June	10.1	8.9	7.5	6.9	7.4	19.3	10.2
July	9.0	7.3	8.9	6.5	8.6	139.0	15.4
August	11.1	11.1	10.9	7.1	8.9	9.2	17.8
September	12.8	19.3	11.2	8.3	10.8	7.8	27.3
October	13.4	80.2	19.8	8.7	11.4	....	66.9
November	....	....	....	11.2	16.3	244.0	....
December	....	....	....	40.0	52.7	36.0	240.0
1916.							
January	....	....	....	28.0	59.0	85.0	45.0
February	....	....	....	....	....	35.0	37.0
Average	13.4	11.9	10.2	8.5	9.7	31.9	18.0

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May see note under Table 4.

FEED USED IN PRODUCING EGGS.

The amount of feed used in producing a dozen eggs is shown in Tables 8, 8a, and 8b. The cost of this feed for each period is shown in Tables 7, 7a, and 7b. The amount of feed is given in addition to the cost so that the cost can be more readily secured at any time regardless of the comparative price of grains.

TABLE 8.—*Feed per dozen eggs for 4-week periods, 1912–13.*

Period.	First laying year.					
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.
1912.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
November	7.0	8.3	17.3	....	....	....
December	9.1	6.4	6.8	....	....	....
1913.						
January	18.1	7.2	7.3	....	....	....
February	7.1	4.1	7.1	4.8	8.7	10.7
March	5.6	4.6	5.3	3.7	6.6	6.9
April	4.8	3.7	4.7	2.7	5.1	4.8
May	4.2	3.5	4.8	2.7	4.9	4.5
May	4.0	3.2	5.0	2.9	5.8	5.5
June	4.3	3.6	5.8	3.3	4.4	5.2
July	5.1	5.1	7.3	4.6	6.2	7.6
August	4.9	4.8	9.7	4.8	7.0	8.2
September	9.1	5.2	9.9	6.4	8.8	12.9
October	13.1	8.4	20.8	11.6	10.1	18.2
November	(66.2)	(15.0)	(22.6)	26.6	17.6	17.6
December	(44.9)	(28.7)	(25.0)	27.3	19.3	15.1
1914.					12.6	
January	(35.8)	(32.9)	(29.5)	16.6		20.3
Average	6.2	4.9	7.0	4.7	7.3	8.1

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May see note under Table 4.

TABLE 8a.—*Feed per dozen eggs for 4-week periods, 1913–14.*

Period.	Second laying year.						First laying year.		
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.	Pen 8.	Pen 9.
1913.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
November	66.2	15.0	22.6	(26.6)	(17.6)	(17.6)	....	....	....
December	44.9	28.7	25.0	(27.3)	(19.3)	(15.1)	4.5	6.1	19.9
1914.									
January	35.8	32.9	29.5	(16.6)	(12.6)	(20.3)	7.2	6.1	27.9
February	7.8	21.0	11.2	4.5	10.1	13.1	6.4	5.0	7.3
March	8.5	9.8	8.4	7.1	7.4	8.6	6.0	4.4	22.7
April	4.5	4.9	6.6	3.5	5.4	7.0	4.3	3.0	3.7
May	5.0	4.9	6.4	3.1	5.2	5.2	3.3	3.0	4.4
May	4.4	6.4	6.5	2.9	5.7	7.4	3.4	2.6	4.4
June	5.7	6.2	8.5	3.2	6.0	5.7	3.5	2.7	6.2
July	6.6	6.1	9.8	4.0	6.7	8.3	6.8	3.2	6.5
August	7.0	7.4	9.5	5.1	6.3	7.9	5.1	4.6	8.0
September	9.9	9.8	10.7	7.7	6.9	12.8	11.9	7.4	10.1
October	25.8	32.3	14.7	15.3	12.4	19.6	14.3	6.9	12.6
November	(154.0)	(345.0)	(26.9)	432.0	17.6	36.3	19.4	9.2	15.9
December	....	(275.0)	(116.2)	....	102.0	135.9	(20.0)	(20.7)	(26.7)
1915.									
January	(171.3)	(416.2)	(113.9)	267.5	128.4	57.6	(9.8)	(10.2)	(39.9)
Average	9.2	9.2	10.3	5.6	8.6	10.6	5.6	4.2	8.2

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May see note under Table 4.

TABLE 8b.—*Feed per dozen eggs for 4-week periods, 1914–15.*

Period.	Third laying year.						Second laying year.		
	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.	Pen 8.	Pen 9.
1914.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
November	154.0	345.0	26.9	(432.0)	(17.6)	(36.3)	(19.4)	(9.2)	(15.9)
December	....	275.0	116.2	....	(102.0)	(135.9)	20.0	20.7	26.7
1915.									
January	171.3	416.2	113.9	(267.5)	(128.4)	(57.6)	9.8	10.2	39.9
February	34.4	52.5	25.2	12.3	14.5	14.7	7.8	5.1	13.3
March	8.9	10.4	8.6	5.3	8.2	9.4	4.9	3.3	6.7
April	7.4	6.1	7.0	3.4	6.3	7.7	4.1	3.3	7.0
May	6.9	5.9	6.4	3.2	7.2	6.5	3.7	3.2	5.6
May	7.8	8.9	5.6	3.6	7.0	6.3	4.1	2.9	6.1
June	8.5	7.8	8.2	3.4	6.2	8.6	4.1	2.8	5.8
July	8.6	13.6	7.4	4.3	9.2	12.3	4.6	3.2	9.6
August	11.9	10.6	13.2	5.0	10.6	13.6	6.5	4.4	11.8
September	15.8	24.0	19.0	7.9	13.8	17.7	7.3	6.3	16.2
October	....	450.5	54.0	88.7	20.7	90.4	18.3	58.9	22.7
November	....	....	....	....	28.9	41.0	162.7	117.9	64.5
December	....	....	....	720.0	585.5	165.0	....	....	....
1916.									
January	....	....	....	27.1	218.0	59.6	....	....	....
February	....	....	....	....	....	....	....	....	....
Average	14.1	16.0	13.1	6.0	11.0	12.9	6.2	4.7	10.7

TABLE 8c.—*Feed per dozen eggs for 4-week periods, 1914–15*—Continued.

Period.	First laying year.						
	Pen 10.	Pen. 11.	Pen 12.	Pen 13.	Pen 14.	Pen 15.	Pen 16.
1914.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
November			28.1				
December	105.7	47.3	10.4				
1915.							
January		13.2	7.5	8.3	7.0		
February	15.1	10.4	5.1	4.8	4.6		
March	6.8	7.1	6.1	4.4	4.5	20.7	12.4
April	5.5	5.3	5.5	3.8	4.6	9.7	7.1
May	4.7	4.5	4.9	4.1	4.6	6.2	4.5
May	5.8	5.1	5.2	4.5	4.7	10.5	4.8
June	6.8	5.9	4.7	4.3	5.4	12.9	6.8
July	6.0	4.8	5.5	4.7	5.7	92.1	10.3
August	7.5	7.3	6.7	5.5	6.9	62.6	11.8
September	8.6	12.7	6.9	5.9	7.4	51.9	18.1
October	9.0	53.3	12.4	7.4	10.5		44.6
November				27.0	34.2	163.6	
December				18.6	37.9	24.0	159.0
1916.							
January						57.8	30.2
February						23.4	25.1
Average	9.0	7.9	6.3	5.6	6.2	21.4	12.0

Figures in parentheses are repetitions, put in for comparison; they are not included in the averages. For repetition of month of May, see note under Table 4.

VALUE OF THE EGGS FROM EACH PEN.

The average value of the eggs per hen, the value over feed cost, and the average yearly value of eggs per dozen for each pen is shown in Table 9, and some interesting comparisons of breeds and feeds are seen in figure 5. The material difference between the excess of egg value over feed cost of hens in the first year and that in the second

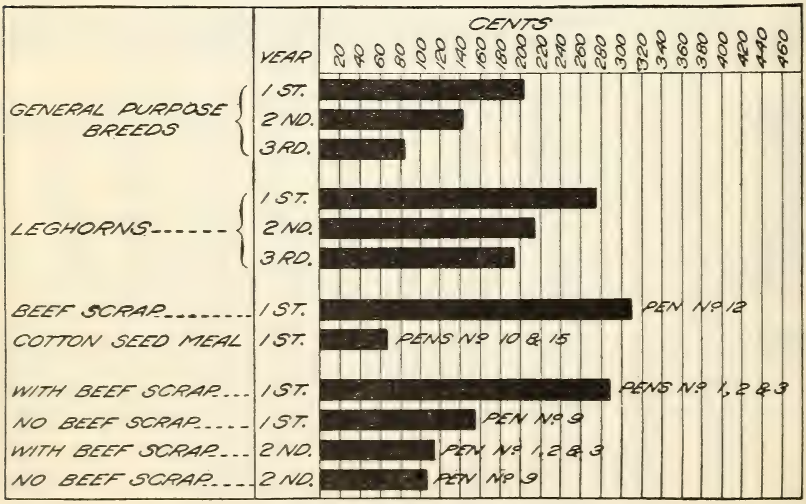


FIG. 5.—Average yearly value of eggs per hen over feed cost.

and third years is clearly shown. The average value over feed cost the first year from Pens 1 to 6 exceeded that of the second year by $1.15 per hen, while the second-year average exceeded the third year by 62 cents. The average decrease from the first to the second year of the early-hatched general-purpose pens (Nos. 1 to 3) was $1.73, compared with 58 cents in the late-hatched pens (Nos. 5 and 6). In their third year the average decrease was 76 cents in the early-hatched pens and 61 cents in the late-hatched pens. The total value of the eggs for two years over cost of feed from Pen 4 (Leghorns) was $4.90, against $4.34 in Pen 2, the highest of any of the general-purpose pens. The total value over feed cost for three years was $6.84 for Pen 4 (Leghorns), against $4.45 for Pen 2. The value of the eggs over feed cost during their third laying year is very much greater for Leghorns than for general-purpose fowls, as shown in this table. The highest average value over feed cost made by any pen during its pullet year was $3.41 in Pen 8 (1914), also a Leghorn pen, which is 15 cents per hen higher than the highest general-purpose pen (Pen 2). Present prices of eggs and feeds should be carefully compared in considering the following table.

TABLE 9.—*Average value of eggs per hen and per dozen.*

Pen.	1912–13			1913–14			1914–15		
	Annual value per hen.	Annual value over feed cost.	Average value per dozen.	Annual value per hen.	Annual value over feed cost.	Average value per dozen.	Annual value per hen.	Annual value over feed cost.	Average value per dozen.
			Cents.			*Cents.*			*Cents.*
1	$4.03	$2.86	33.9	$2.32	$1.25	31.0	$1.70	$0.39	28.9
2	4.20	3.26	34.6	2.03	1.08	31.3	1.34	.11	28.3
3	3.66	2.50	34.5	2.11	1.08	32.6	1.52	.65	30.5
4	3.59	2.72	30.4	3.03	2.18	30.9	2.78	1.94	29.1
5	3.33	2.17	32.3	2.82	1.67	33.1	2.14	.95	30.9
6	3.21	1.88	31.9	2.54	1.22	32.6	2.11	.71	30.0
Average	3.67	2.56	32.9	2.47	1.41	31.9	1.93	.79	29.6
7				3.33	2.45	32.9	2.76	1.92	30.9
8				4.29	3.41	32.7	3.74	2.81	30.1
9				2.43	1.55	32.5	2.14	1.07	30.8
10							2.49	1.39	30.4
11							2.54	1.53	29.8
12							4.58	3.14	32.3
13							3.98	2.96	32.8
14							4.35	3.03	32.0
15							.87	[1]—.04	30.3
16							1.67	.63	29.0

[1] The minus sign denotes a loss.

The averages for Pens 7 to 16 omitted; see note under Table 2. Note present prices of eggs and feed.

Quotations of nearby eggs on the New York wholesale market were used in calculating the market value of these eggs. The prices of a dozen eggs used in this bulletin for each year (13 periods of 4 weeks each), beginning November 1, are as follows: 61, 49, 44, 38.5, 31.5, 24.5, 23.5, 24, 27.5, 30.5, 35, 39, and 49 cents, with an average monthly price for the year of 36.7 cents. However, farmers do not usually receive the prices quoted for "nearby" eggs, the best of their eggs being sold as "firsts." The quotations for "firsts" shipped to the New York market were as follows for the corresponding periods, beginning November 1: 40, 39, 35.5, 31, 30.5, 20.5, 20.5, 21.5, 22.5, 23.5, 25, 27.5, and 29 cents, or a monthly average of 28.2 cents. Using the latter figures, the average value over feed cost of eggs produced in 1912–1913 (their pullet year) in Pens 1 to 6 was $1.51, against $2.56 for nearby eggs, and 93 cents, against $1.41 in 1913–1914 (their second year). The average figured on this quotation for Pens 7 to 9 in 1914 would be $1.80, as against $2.47 for the nearby eggs. It would be necessary for a poultryman to secure the prices quoted on nearby eggs in order to make a fair profit on the basis of the feed costs given in this bulletin.

BROODINESS IN FOWLS.

Broodiness has a material bearing on egg production. In this work the broody hens were removed to small crates to break up their desire to sit. The number of times that hens in each pen were put into the broody coops is shown in Table 2. The length of time that the hens were thus confined varied from 3 to 10 days. Pen 5 contained the largest number of broody hens, there having been 111 instances in 1913, 82 in 1914, and 46 in 1915. Pen 3, which had the next highest number, contained 14 Buff Orpingtons, among which broodiness was much more frequent than among the 16 Rhode Island Reds which made up the rest of the pen. The 11 Orpingtons which were in the pen throughout the year (1912–1913) became broody 56 times, an average of 5.2 times per hen, against 1.7 times per hen among the Rhode Island Reds. Five of the Rhode Island Reds did not become broody during the year, while all the Orpingtons were broody at least three times. This undoubtedly lowered the egg yield materially in Pen 3. Two or more of the Orpingtons were broody during every month of the year except November, while practically all of the broodiness among the Rhode Island Reds occurred between the end of March and the first of August. The proportion of Orpingtons in the other pens was comparatively small, but this same tendency to excessive broodiness has been noted in practically all the Buff Orpingtons used at the farm.

The broodiness in Pen 1 (Rhode Island Reds) in the hens which lived through the year (1912–13) was 2.3 times per hen, which was more than that of the Rhode Island Reds in Pen 3. The Barred Plymouth Rocks in Pen 5 were broody more times than hens of this breed in any of the other pens. The greatest broodiness occurred in

Pens 3 and 5, where a very large proportion of corn meal (about 65 per cent) was fed in the mash. The statement is often made that the number of broody hens can be increased by feeding freely on corn and corn meal. This would appear to be verified by the total broodiness in Pens 3 and 5, all breeds considered; but it is not true of the Rhode Island Reds in Pen 3 compared with those in Pen 1. Broodiness in the hens in their first, compared with their second laying year, averaged about the same for Pens 1 to 6, increasing slightly during the second year in Pens 1, 4, and 6, and decreasing in the other pens. Broodiness decreased very materially in 1915 during the third laying year. The percentage of hens of each breed broody before April 1 of their pullet year from the early-maturing pens (Nos. 1 to 3) was practically the same as from the late-maturing pens (Nos. 5 and 6) except in the Buff Orpingtons, where the percentage was twice as great in the early-maturing pens.

Broodiness is probably largely an individual characteristic, more or less affected by strains, variety, or breed, and by the quantity of corn or corn meal in the ration, but not materially affected by ordinary differences in rations. Further observations on this characteristic are being made in the feeding pens and in a pen of Buff Orpingtons in which trap-nest records of the hens are kept. Broody hens are occasionally found among the White Leghorns, as shown in all of the White Leghorn pens in the year 1913–14. Freedom from broodiness accounts for the higher egg production of Leghorns during the spring and summer, compared with the general-purpose breeds. Frequent broodiness is an undesirable trait in hens kept only for egg production, but may be of considerable value in flocks where natural methods of incubation and brooding are used.

EFFECT OF THE MOLT ON EGG YIELD.

Molting materially affects the egg yield, as hens take from 3 to 5 months to molt and lay few if any eggs while molting. The period of molting begins usually about the first of August, but apparently varies somewhat with the season. The pullets started to molt earlier in 1914 than in 1913. The period of molting was from 3 to 6 weeks longer in the second laying year than in the first, and was still somewhat longer in the third than in the second year, while the accompanying period of nonproduction was materially increased in the third year. The late-maturing pens started to molt later than the early-maturing pens, but took about the same average time to molt. No material effect on the molting was apparent from the various rations used, although the molting period varied slightly in all of the pens. More records of the molting of hens are being kept both in the feeding pens and in breeding pens, where individual records of egg yield of each hen are kept.

A feeding test covering four months made in 1913 in a mixed flock of 70 general-purpose pure-bred hens from 1 to 3 years of age, showed that no material benefit in molting was secured by the addition of 10 per cent of linseed meal to the mash. The length of the molting period and the egg yield were practically the same as in the check pen, although the pen receiving the linseed meal produced more eggs during the first part of the molting period and their feathers appeared smoother and more glossy during the entire period.

VARIATION IN WEIGHT OF THE HENS.

Table 10 shows the average weight of the hens in Pens 1 to 6 for three years; in Pens 7 to 9 for two years; and for one year in the rest of the pens. The period of greatest average weight occurs in the spring, while the lowest average weight is during the molting period, which is also true of the weight of the eggs. The average weights for each year are given at the bottom of the table. The figures show a tendency for the hens of the general-purpose breeds, especially the Barred Plymouth Rocks and the White Wyandottes, to become too fat. The increase in the average monthly weight of hens of the general-purpose breeds in their second over their first year was about 0.5 of a pound, compared with an average increase of only 0.16 of a pound for the Leghorns. From their second to the third year the average increase in the general-purpose pens was 0.22 of a pound, compared with 0.17 in Pen 4 (Leghorns). The tendency of the method of feeding in Pen 6 to keep the hens too fat is shown in the average monthly weights of this pen, which exceeded all the other general-purpose pens by 0.45 of a pound, or about 8 per cent. The average weights and the increase in weight from the second to third year are largest in this pen.

Pen 9, which did not receive any beef scrap, had a monthly average weight of 0.79 of a pound less than the average of the other general-purpose hens during their first year. The increase in weight, however, from the first to the second year in this nonbeef-scrap pen was 0.55 of a pound, or about the same as in the beef-scrap pens. Pens 10 and 11, fed cottonseed meal, averaged 1 pound less in weight than Pen 12, fed beef scrap. The average weight of Pens 15 and 16, also cottonseed-meal pens, is much below the average of the beef-scrap pens. The hens in the pens fed cottonseed meal were thin and in poor flesh all the time. This was probably partly due to the fact that these hens did not like the cottonseed meal and ate a very small amount of the mash. Their total feed consumption was considerably below that of the beef-scrap pens. The results secured with cottonseed meal are discussed more in detail on page 13.

TABLE 10.—*Monthly average weight per hen.*

Month.	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.	Pen 6.	Pen 7.	Pen 8.	Pen 9.	Pen 10.	Pen 11.	Pen 12.	Pen 13.	Pen 14.	Pen 15.	Pen 16.
1912.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
November	5.45	5.22	4.83	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
December	5.17	5.63	5.56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1913.																
January	5.56	5.67	5.73	3.23	5.65	6.12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
February	5.88	5.78	5.91	3.28	6.04	6.17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
March	6.06	6.02	5.82	3.37	6.14	6.28	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
April	6.11	6.29	5.92	3.36	5.88	6.41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
May	5.83	6.08	5.63	3.38	5.78	6.41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
June	5.73	6.08	5.47	3.18	5.76	6.15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
July	5.65	6.13	5.45	3.16	5.40	6.01	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
August	5.39	5.84	5.28	3.14	5.40	5.96	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
September	5.46	5.98	5.47	3.10	5.55	6.07	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
October	5.85	6.19	5.77	3.04	5.61	5.96	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
November	5.56	5.81	5.71	3.18	5.58	6.17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
December	6.00	5.85	6.03	3.40	6.16	6.50	3.40	3.32	5.36	.....	.....	.....	.....	.....	.....	.....
1914.																
January	6.45	6.25	6.30	3.59	6.32	6.75	3.42	3.29	5.43	.....	.....	.....	.....	.....	.....	.....
February	7.01	6.92	6.80	3.43	6.70	7.15	3.40	3.31	5.67	.....	.....	.....	.....	.....	.....	.....
March	6.86	7.06	6.81	3.30	6.79	7.22	3.48	3.47	5.53	.....	.....	.....	.....	.....	.....	.....
April	6.80	6.83	6.33	3.38	6.59	7.16	2.92	3.50	5.18	.....	.....	.....	.....	.....	.....	.....
May	6.38	6.85	5.73	3.43	6.37	6.66	3.15	3.50	4.76	.....	.....	.....	.....	.....	.....	.....
June	6.34	6.28	5.52	3.36	6.27	6.65	3.05	3.31	4.67	.....	.....	.....	.....	.....	.....	.....
July	6.47	6.23	5.57	3.39	6.21	6.63	3.03	3.32	4.59	.....	.....	.....	.....	.....	.....	.....
August	6.41	6.42	5.74	3.25	6.00	6.57	3.18	3.19	4.38	.....	.....	.....	.....	.....	.....	.....
September	6.36	6.30	5.85	3.03	6.11	6.30	3.22	3.13	4.55	.....	.....	.....	.....	.....	.....	.....
October	5.95	5.97	5.90	3.09	6.20	6.53	3.16	3.29	4.87	.....	.....	.....	.....	.....	.....	.....
November	5.97	5.70	6.07	3.14	6.00	6.44	3.51	3.52	5.42	3.44	3.70	3.38	.....	.....	.....	.....
December	6.10	5.76	5.98	3.23	5.93	6.64	3.68	3.38	5.62	3.71	3.91	4.37	.....	.....	.....	.....
1915.																
January	6.48	6.28	6.57	3.69	6.66	7.26	3.81	3.61	5.69	4.01	4.64	5.37	4.66	4.55	.....	.....
February	6.92	6.93	7.24	3.90	6.92	7.63	3.76	3.95	6.02	4.35	4.83	5.53	5.08	4.79	.....	.....
March	7.18	7.54	7.35	3.67	6.90	7.51	3.54	3.85	5.86	4.34	4.63	5.39	5.15	4.74	4.76	4.65
April	7.14	7.12	6.74	3.61	6.82	7.42	3.45	3.68	5.63	4.33	4.30	5.57	5.19	4.61	4.52	4.22
May	6.74	6.73	5.93	3.57	6.57	7.27	3.10	3.75	5.53	4.27	4.03	5.68	4.99	4.71	3.82	3.96
June	6.69	6.82	5.88	3.53	6.48	6.89	3.12	3.82	5.75	4.35	4.22	5.55	5.03	4.76	3.60	3.83
July	6.45	6.56	5.98	3.42	6.44	6.86	3.13	3.75	5.43	4.21	4.21	5.57	4.81	4.79	3.58	3.74
August	6.44	6.55	5.81	3.40	6.55	6.83	3.16	3.53	5.24	4.18	4.13	5.52	5.02	4.66	3.51	3.77
September	6.63	6.43	5.87	3.29	6.43	6.69	3.30	3.53	5.18	4.43	4.24	5.41	4.97	4.64	3.41	3.83
October	6.30	6.00	5.85	2.93	6.03	6.38	3.45	3.41	5.44	4.48	4.23	5.24	4.89	4.58	3.56	3.84
November	.....	.....	.....	3.19	6.13	6.50	3.20	3.14	5.59	.....	.....	.....	4.86	4.63	3.86	3.92
December	.....	.....	.....	3.42	6.26	6.94	.....	.....	.....	.....	.....	.....	4.75	4.36	4.08	4.29
1916.																
January	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.15	4.68
February	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.26	4.57
Annual averages:																
1913	5.68	5.91	5.57	3.23	5.75	6.18	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1914	6.38	6.40	6.02	3.30	6.29	6.72	3.24	3.35	5.03	.....	.....	.....	.....	.....	.....	.....
1915	6.58	6.54	6.27	3.47	6.51	7.01	3.40	3.61	5.58	4.18	4.25	5.21	4.95	4.65	3.92	4.11

BALANCED RATIONS.

The proportion of grain and mash, the cost of 100 pounds of the ration, and the nutritive ratio are given in Table 11. The cost of 100 pounds of feed from the different rations varies somewhat according to the proportion of mash and grain and to the nature of the ration, although this difference is not large except in Pen 9, in which the feed is from 10 to 20 cents per 100 pounds cheaper than in the other pens. The nutritive ratio and the cost of the ration in the cottonseed pens (Nos. 10, 11, 15, and 16) was quite low, but the cost of production was very high. The cost of the ration in Pen 9 is the lowest because it does not contain beef scrap, but this ration produced eggs at the highest cost per dozen during the pullet year in the pens with which it is directly comparable (Nos. 1, 2, and 3 in 1912–1913).

The lower the nutritive ratio the higher the cost of feed per 100 pounds, because of the higher protein content. The nutritive ratio widened considerably in 1915 in all the pens which were allowed to balance their own ration (Nos. 3, 4, and 7), regardless of whether it was their second or third laying year. The hens apparently did not relish the beef scrap as well in 1915 as in the previous year, although the same brand of beef scrap was used. This widening of the ration in Pens 3, 4, and 7, compared with Pens 5 and 8 where the beef scrap was constant, did not change the relative position of these pens in cost of egg production, but may have tended to lower the actual production. The highest-priced ration, that used in Pen 6, was high in price because of the small proportion of ground feed, and produced eggs at the highest cost of any pen during its first two years, regardless of conditions. The rations fed in the different pens are given in Table 1.

TABLE 11.—*Proportion of grain and mash in ration, cost per 100 pounds, and nutritive ratio.*

Year.	Pen.	Ration.			Nutritive ratio.
		Grain.	Mash.	Cost per 100 pounds.	
		Per cent.	*Per cent.*		
1913	1	65	35	$1.58	1:4.5
1914		56	44	1.57	1:4.0
1915		45	55	1.59	1:3.4
1913	2	76	24	1.59	1:5.6
1914		58	42	1.59	1:4.3
1915		47	53	1.62	1:3.7
1913	3	64	36	1.56	1:5.5
1914		52	48	1.55	1:5.1
1915		43	57	1.49	1:6.9
1913	4	67	33	1.57	1:5
1914		54	46	1.56	1:4.8
1915		50	50	1.48	1:7.7
1913	5	59	41	1.53	1:5.2
1914		47	53	1.57	1:4.7
1915		43	57	1.57	1:4.5
1913	6	84	16	1.63	1:4.8
1914		74	26	1.60	1:4.9
1915		73	27	1.55	1:5.9
		Per cent.	*Per cent.*		
1914	7	53	47	$1.56	1:4.7
1915		45	55	1.50	1:6.4
1914	8	57	43	1.58	1:4.5
1915		52	48	1.60	1:4.2
1914	9	70	30	1.43	1:7.8
1915		52	48	1.43	1:7.4
1915	10	61	39	1.49	1:4.9
1915	11	54	46	1.50	1:4.6
1915	12	48	52	1.61	1:4.1
1915	13	50	50	1.51	1:4.5
1915	14	46	54	1.57	1:4.1
1915	15	56	44	1.49	1:4.6
1915	16	69	31	1.50	1:5.4

The nutritive ratios are narrower in all the pens except Pen 6 in their second year, especially in Pens 1 and 2, because the proportion of mash was considerably increased. These ratios are still narrower in their third year (1915), except in those pens allowed to select their own mash constituents. The feeds and method of feeding have as much if not more influence on results as the nutritive ratio, as shown in the case of Pen 9, which has a very wide nutritive ratio and one which is supposed to represent a fattening ration, but the birds gained less in weight and were thinner throughout the year in this pen than in any of the other general-purpose pens (see Table 10). This ration, however, was deficient in animal protein. The hens increased more in weight and were fatter in Pen 6 than in any other pen, although the nutritive ratio was lower in this pen than in several of the other general-purpose pens. However, with similar methods of feeding and normal rations, the wider nutritive ratios represent the most fattening rations. A nutritive ratio of about 1 to 4.5 has given good results in all of these experiments, although satisfactory results were secured on rations having widely varying ratios.

The digestible nutrients in 100 pounds of the various feeds used are shown in Table 12, while Table 13 shows these digestible nutrients in 100 pounds of the actual feed or ration given to each pen during these experiments. The digestibility of the feeds in these tables is based on experiments conducted with farm animals, as no figures of this nature are available on poultry.

TABLE 12.—*Digestible nutrients in 100 pounds of feeds used.*

Feed.	Crude protein.	Carbohydrates.	Fat.	Feed.	Crude protein.	Carbohydrates.	Fat.
	Pounds.	*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*
Wheat	8.8	67.5	1.5	Wheat bran	11.9	42.0	2.5
Oats	8.8	49.2	4.3	Wheat middlings	13.0	45.7	4.5
Corn	7.8	66.8	4.3	Beef scrap	66.2	....	13.4
Barley	8.4	65.3	1.6	Cottonseed meal	37.6	21.4	9.6
Corn meal	6.1	64.3	3.5	Fish meal	60.5	....	14.6

TABLE 13.—*Digestible nutrients in 100 pounds of feed consumed.*

Pen.	Year.	Crude protein.	Carbohydrates.	Fat.	Nutritive ratio.	Pen.	Year.	Crude protein.	Carbohydrates.	Fat.	Nutritive ratio.
		Pounds.	*Pounds.*	*Pounds.*				*Pounds.*	*Pounds.*	*Pounds.*	
1	1913	14.1	53.1	4.3	1:4.5	6	1913	13.4	56.4	3.9	1:4.8
	1914	15.4	51.0	4.5	1:4.0		1914	13.1	56.0	3.9	1:4.9
	1915	17.1	48.3	4.8	1:3.4		1915	11.2	57.8	3.6	1:5.9
2	1913	12.1	60.1	3.6	1:5.6	7	1914	13.9	55.0	4.4	1:4.7
	1914	15.0	64.3	4.2	1:4.3		1915	10.6	58.9	4.0	1:6.4
	1915	16.8	51.5	4.5	1:3.7						
						8	1914	14.4	54.6	4.5	1:4.5
3	1913	12.1	56.6	4.1	1:5.5		1915	15.1	53.7	4.6	1:4.2
	1914	12.9	55.8	4.3	1:5.1						
	1915	9.8	59.3	3.8	1:6.9	9	1914	8.5	58.4	3.4	1:7.7
							1915	8.8	57.6	3.3	1:7.4
4	1913	13.2	55.9	4.3	1:5.0						
	1914	13.5	55.3	4.4	1:4.8	10	1915	12.6	53.1	4.1	1:4.9
	1915	8.9	60.7	3.7	1:7.7	11	1915	13.5	52.1	4.3	1:4.6
						12	1915	15.6	53.2	4.7	1:4.1
5	1913	12.5	56.0	4.2	1:5.2	13	1915	14.0	52.2	4.5	1:4.5
	1914	13.8	54.4	4.4	1:4.7	14	1915	15.1	51.4	4.5	1:4.1
	1915	14.3	53.8	4.5	1:4.5	15	1915	13.2	51.9	4.2	1:4.6
						16	1915	12.0	55.1	4.0	1:5.4

Digestible protein, energy values, and total dry matter of the feedstuffs, as given in Department of Agriculture Bulletin No. 459, are shown in Table 14. These values are those worked out for farm animals; no figures of this kind are available in poultry feeding. Detailed figures showing the energy values of the rations used are given in Table 15, based on the assumption that these figures apply more or less accurately to poultry.

TABLE 14.—*Average dry matter, digestible true protein, and net energy values in 100 pounds of various poultry feeds.*

Feed.	Dry matter.	Digestible protein.	Net energy.
	Pounds.	*Pounds.*	*Therms.*[1]
Wheat	89.8	8.1	91.82
Oats	90.8	8.7	67.56
Corn	89.5	7.0	89.16
Barley	90.7	8.3	89.94
Corn meal	88.7	6.4	88.75
Wheat bran	89.9	10.8	53.00
Wheat middlings	89.6	12.0	59.10
Beef scrap	92.5	45.5	72.96
Cottonseed meal	92.5	35.4	93.46

[1] A therm is the quantity of heat required to raise the temperature of 1,000 kilograms (2,204.6 pounds) of water 1° C. It is equal to 1,000 large, or kilogram, calories.

TABLE 15.—*Dry matter, digestible protein, and energy values in 100 pounds of feed consumed.*

Pen.	Year.	Dry matter.	Digestible protein.	Net energy.
		Pounds.	*Pounds.*	*Therms.*
1	1913	90.0	11.70	77.77
	1914	90.2	12.66	76.50
	1915	90.0	13.86	74.82
2	1913	89.6	10.17	85.04
	1914	89.8	12.22	81.25
	1915	89.8	13.46	78.57
3	1913	89.9	10.33	81.66
	1914	89.8	10.90	82.16
	1915	89.5	8.88	83.83
4	1913	89.7	11.06	82.39
	1914	89.9	11.26	82.38
	1915	89.4	8.24	84.64
5	1913	89.8	10.66	81.58
	1914	89.8	11.52	81.26
	1915	89.8	11.78	81.06
6	1913	90.4	11.31	82.81
	1914	90.3	11.16	81.77
	1915	90.1	9.91	81.67
7	1914	89.9	11.58	82.36
	1915	89.6	9.35	84.56
8	1914	90.0	11.90	82.50
	1915	89.8	12.31	82.38
9	1914	89.8	8.46	78.64
	1915	89.4	8.39	77.61
10	1915	90.1	11.88	79.77
11	1915	90.1	12.46	79.50
12	1915	89.8	12.61	82.34
14	1915	89.9	12.45	77.25
15	1915	90.2	12.46	79.34
16	1915	90.2	10.97	80.68

SUMMARY.

This bulletin shows the results obtained in feeding experiments covering 3 years' work. In the third year 16 pens were under observation, containing a total of 366 laying hens.

The average egg yield for the first laying year in all pens was 131 eggs, and the highest pen average yield was 169.5 eggs. In the second year the average egg yield of all pens was 92.7 eggs, which decreased to 78.2 eggs in the third laying year.

Eggs were produced at an average cost for feed only of 10 cents a dozen during the pullet year, of 14 cents in the second year, and 19 cents in the third year.

Prices of individual grains in 1917 are from 20 to 100 per cent higher than the prices used in this bulletin, which should be carefully considered in estimating the present cost of egg production.

The average value of eggs over feed cost the first laying year was $2.56 per hen, falling to $1.41 the second year, and to $0.79 the third year. The highest average value in any pen was $3.41 (Pen 8).

The general-purpose fowls consumed annually 72 pounds of feed which cost $1.13, while the Leghorns ate 55 pounds, which cost 87 cents.

Good results were obtained with rations both with and without oats. The use of this grain added variety to the ration without increasing the cost.

Fowls not fed any beef scrap or other animal protein laid only 90 eggs during their pullet year compared with 137 eggs from the beef-scrap pens, and 84 compared with 83 in their second year. The eggs of the no beef scrap pens cost about 2.2 cents per dozen more to produce the first laying year, but these costs were about equal during the second year. The fowls not fed beef scrap laid very poorly in winter, thus materially reducing the value of their eggs.

Cottonseed meal used in place of beef scrap as a high-protein feed in the ration produced brown or greenish spots on the yolks of the eggs, especially in warm weather, making a considerable proportion of them unfit for market. Eggs were produced more cheaply and at a considerably greater profit on the beef-scrap ration.

Fish meal at $7 a ton less than beef scrap proved to be a good high-protein feed, which can be used to advantage to replace beef scrap. The fish meal did not in any way affect the flavor or quality of the eggs.

General-purpose fowls allowed to select their own mash constituents ate a dry mash containing about 63 per cent corn meal, 19 per cent beef scrap, 9 per cent bran, and 9 per cent middlings. Leghorns ate a mash of about 66 per cent corn meal, 26 per cent beef scrap, and 4 per cent each of bran and middlings. No better results were obtained by this method of feeding than where the ground grains were mixed together in a mash.

Good mashes, as indicated by these experiments, may be made of 66 per cent corn meal, 26 per cent beef scrap, and 4 per cent each of bran and middlings, or 2 pounds of corn meal and 1 pound each of bran, middlings, and beef scrap, with a scratch feed in each ration of equal parts by weight of cracked corn, wheat, and oats, which is fed so that the hens receive about equal parts of scratch feed and of mash.

The Leghorns on free range gave a considerably greater egg yield than those confined to a fair-sized yard. This difference was less marked in the general-purpose hens.

Sprouted oats fed as green feed to hens confined to yards cost about 10 cents per hen a year and 1 cent per dozen eggs, not including any charges for labor and equipment. The hens ate on an average in one year about 1.3 pounds of oyster shell and 0.7 of a pound of grit, which together cost about 1 cent per hen.

The Leghorns did not lay as well in the winter as the general-purpose breeds, especially during their second year, but the Leghorns produced eggs about 3 cents per dozen cheaper during their first year, 6.4 cents cheaper in their second year, and 9.8 cents cheaper in their third year than the general-purpose breeds. One pen of Leghorn pullets (Pen 8) produced eggs in their first year at a feed cost of 6.7 cents per dozen, while the value of the eggs per hen for the year was $3.41 over cost of feed.

The average weight of a dozen eggs from the general-purpose fowls during their pullet year was 1.53 pounds, 1.60 during their second year, and 1.63 during their third laying year. The eggs from the Leghorns averaged 1.45 pounds during their pullet year, and 1.49 during their second and third years.

The egg production of the general-purpose fowls decreased 32 per cent in their second laying year. The decrease was considerably less in the Leghorns, their 2-year average egg production exceeding that of the general-purpose breeds by 19 eggs. The decrease in production from the second to the third year was only 4 per cent with the Leghorns, compared with 13 per cent in the general-purpose breeds.

The cheapest eggs are produced in the spring, during April, May, and June, while the greatest costs occur in October, November, and December. The lowest monthly feed cost of a dozen eggs in any of these experiments was 4 cents, while in some cases no eggs at all were produced during the month.

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